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Counseling and Behavioral Interventions for Healthy Weight and Weight Gain in Pregnancy: A Systematic Review for the U.S. Preventive Services Task Force

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Prepared by:
Pacific Northwest Evidence-Based Practice Center
Oregon Health & Science University
Mail Code: BICC
3181 SW Sam Jackson Park Road
Portland, OR 97239
www.ohsu.edu/epc

Investigators:
Amy Cantor, MD, MPH
Rebecca M. Jungbauer, DrPH
Marian S. McDonagh, PharmD
Ian Blazina, MPH
Nicole E. Marshall, MD, MCR
Chandler Weeks, MPH
Rongwei Fu, PhD
Erin S. LeBlanc, MD, MPH
Roger Chou, MD

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The information in this report is intended to help healthcare decision makers—patients and clinicians, health system leaders, and policymakers, among others—make well-informed decisions and thereby improve the quality of healthcare services. This report is not intended to be a substitute for the application of clinical judgment. Anyone who makes decisions concerning the provision of clinical care should consider this report in the same way as any medical reference and in conjunction with all other pertinent information (i.e., in the context of available resources and circumstances presented by individual patients).

The final report may be used, in whole or in part, as the basis for development of clinical practice guidelines and other quality enhancement tools, or as a basis for reimbursement and coverage policies. AHRQ or U.S. Department of Health and Human Services endorsement of such derivative products may not be stated or implied.

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Structured Abstract

Background: Counseling and active behavioral interventions to limit excess gestational weight gain (GWG) during pregnancy may improve health outcomes for women and infants.

Purpose: To synthesize evidence on the effects of counseling and active behavioral interventions for healthy weight and weight gain during pregnancy for the United States Preventive Services Task Force (USPSTF).

Data Sources: Cochrane Central Register of Controlled Trials (through March 20, 2020) and Cochrane Database of Systematic Reviews (through March 20, 2020), and MEDLINE (1946 to March 20, 2020), and manually reviewed reference lists, with surveillance through August 31, 2020.

Study Selection: English-language randomized controlled trials and controlled trials of the effectiveness, benefits, and adverse effects of counseling and active behavioral interventions to limit excess GWG during pregnancy or in women planning pregnancy, including adolescents.

Data Extraction: One investigator abstracted details about study design, patient population, setting, intervention, followup, and results, reviewed by a second investigator for accuracy. Two investigators independently assessed study quality using methods developed by the USPSTF. Discrepancies were resolved through consensus.

Data Synthesis (Results): Sixty-eight trials (64 randomized clinical trials and 4 nonrandomized trials) of interventions to limit excess GWG during pregnancy were included. Sixty-seven trials evaluated interventions during pregnancy and one trial evaluated an intervention prior to pregnancy.

GWG interventions were associated with small, but statistically significant reductions in risk of gestational diabetes mellitus (GDM) (43 trials; relative risk [RR], 0.87 [95% confidence interval (CI), 0.79 to 0.95]; I^2=16.4%; absolute risk difference [ARD], -1.6% [95% CI, -2.5 to -0.7]) and emergency cesarean delivery (13 trials; RR, 0.87; [95% CI, 0.75 to 0.98]; I^2=0%; ARD, -2.2% [95% CI, -4.0 to 0.0]). There was no association between GWG interventions versus controls for gestational hypertension (28 trials; RR, 0.87 [95% CI, 0.70 to 1.04]; I^2=32.5%; ARD, -0.8% [95% CI, -1.9 to 0.2]), risk of cesarean delivery (34 trials; RR, 0.98 [95% CI, 0.91 to 1.04]; I^2=10.8%; ARD, -0.7% [95% CI, -2.4 to 0.8]), preeclampsia (27 trials; RR, 0.98 [95% CI, 0.84 to 1.13], I^2=0%; ARD, 0.1% [95% CI, -0.6 to 0.5]), postpartum hemorrhage (9 trials; RR, 1.00 [95% CI, 0.88 to 1.15]; I^2=0%; ARD, -0.1% [95% CI, -1.3 to 1.5]), or perineal trauma (8 trials; RR, 0.86 [95% CI, 0.52 to 1.50]; I^2=57.0%; ARD, -0.7% [95% CI, -3.2 to 1.7]). Stratified analyses demonstrated statistically significant interactions between effects of GWG interventions on gestational hypertension, high intensity interventions (p=0.006 for interaction) and active interventions (p<0.001 for interaction); and effects on perineal trauma and BMI category (p=0.003 for interaction) and intervention intensity (p=0.003 for interaction); but subgroup effects were not observed for other maternal health outcomes. GWG interventions were not associated with maternal death (2 trials), but data were limited by few trials and low event rates.

Data on interventions to reduce prepregnancy weight were limited. One trial showed a reduction in prepregnancy weight loss associated with a counseling intervention; however, intervention participants gained more weight versus controls during pregnancy (13.2 kg vs. 10.3 kg, p=0.03), with no effect on rates of excess GWG.

For infant health outcomes, GWG interventions were associated with decreased risk of infant macrosomia (25 trials; RR, 0.77 [95% CI, 0.65 to 0.92]; I^2=38.3%; ARD, -1.9% [95% CI, -3.3 to -0.7]) and large for gestational age (26 trials; RR, 0.89 [95% CI, 0.80 to 0.99]; I^2=0%; ARD, -1.3, [95% CI, -2.3 to -0.3]), but were not associated with risk of preterm birth, respiratory distress syndrome, shoulder dystocia, or neonatal intensive care unit admission. GWG interventions were not associated with neonatal death or stillbirth (11 trials); data were limited by few trials and low event rates. Stratified analyses demonstrated statistically significant interactions between effects of GWG interventions on macrosomia and high intensity interventions (p=0.03 for interaction), but subgroups effects were not observed for other infant health outcomes.

GWG interventions were associated with one kilogram lower weight gain across all prepregnancy weight categories (55 trials; pooled mean difference [MD], -1.02 kg [95% CI, -1.30 to -0.75]; I^2=60.3%). High-intensity interventions (12 or more sessions) were associated with greater effects (28 trials; MD, -1.47 kg [95% CI, -1.78 to -1.22]; I^2=13.0%) than moderate- (3-11 sessions) (18 trials; MD, -0.32 kg [95% CI, -0.71 to -0.04]; I^2=17.6%) or low-intensity interventions (fewer than 2 sessions) (9 trials; MD, -0.64 kg [95% CI, -1.44 to 0.02]; I^2=48.4%; p<0.001 for interaction). There was no interaction between intervention type (active vs. counseling only) or baseline BMI category and effects on GWG. Interventions were also associated with a lower likelihood of gaining gestational weight in excess of the Institute of Medicine (IOM) recommendations (39 trials; RR, 0.84 [95% CI, 0.78 to 0.90]; I^2=63.2%; ARD, -7.7% [95% CI, -11.0 to -4.6]), with greater effect for active (p<0.001 for interaction) and high intensity interventions (p<0.001 for interaction); there was no interaction between BMI category and effects on likelihood of excess weight gain. GWG interventions were not associated with increased likelihood of adherence to IOM recommendations for GWG (i.e., neither gaining excessive weight nor failing to gain sufficient weight) or postpartum weight retention at less than 6 or 6 months, but were associated with reduced postpartum weight retention at 12 months (10 trials; MD, -0.63 kg [95% CI, -1.44 to -0.01]; I^2=65.5%).

Data on harms were limited. Twelve studies of the effects of GWG interventions on maternal anxiety and depression showed mixed results. The pooled estimate of the effect of maternal GWG interventions on infants small for gestational age was not statistically significant (20 trials; RR, 0.94 [95% CI, 0.80 to 1.10]; I^2=0%; ARD, -0.4% [95% CI, -1.7 to 1.0]). Stratified analyses demonstrated a statistically significant interaction between SGA and intervention intensity (p=0.04 for interaction), but not BMI category or intervention type.

Limitations: Restricted to English-language articles, statistical heterogeneity in pooled analyses, limited evidence on infant health outcomes and harms of interventions, and most trials had some methodological limitations. Data were lacking on effectiveness of prepregnancy interventions, and on GWG interventions in pregnant adolescents and women with advanced maternal age.

Conclusions: Counseling and active behavioral interventions to limit GWG in pregnant women are associated with a modestly decreased risk of GDM, emergency cesarean delivery, macrosomia, and large for gestational age. GWG interventions are also associated with modest reductions in weight gain and decreased likelihood of exceeding IOM recommendations for GWG. Effects of these interventions on mean GWG are slightly more pronounced for high intensity interventions.

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Chapter 1. Introduction and Background

Purpose

This report will be used by the U.S. Preventive Services Task Force (USPSTF) to inform a recommendation on counseling and behavioral interventions for women in primary care settings to prevent adverse health outcomes associated with obesity during pregnancy and excess gestational weight gain (GWG) during pregnancy. The USPSTF has not previously made a recommendation on this topic.

Condition Background

Condition Definition

The 2009 Institute of Medicine (IOM) recommendations for healthy GWG vary according to prepregnancy weight category.[1] Gestational weight gain is usually defined as change in weight measured before pregnancy (prepregnancy) or during the first trimester, to weight measured at the end of pregnancy (e.g., prior to delivery). Weight measured during the first prenatal visit is commonly accepted as a baseline measurement since many women gain little weight during the first trimester of pregnancy.[1] Prepregnancy weight categories are based on the World Health Organization categories for nonpregnant persons, defined as underweight (body mass index [BMI] less than 18.5 kg/m^2), normal or healthy weight (BMI 18.5 to 24.9 kg/m^2), overweight (BMI 25 to 29.9 kg/m^2), and obese (BMI 30 kg/m^2 and greater).[1-3] The 2009 IOM recommendations for healthy GWG are 28-40 pounds (lbs.) for women in the prepregnancy underweight category, 25-35 lbs. for normal prepregnancy weight, 15-25 lbs. for prepregnancy overweight category, and 11-20 lbs. for prepregnancy obese category.[1] The IOM did not make recommendations about weight gain for women in different classes of obesity. The 2009 guidelines also include recommendations for weight gain by trimester and weight gain per week in the 2nd and 3rd trimester, which can be used to compare GWG among women with different lengths of gestation. Because prepregnancy BMI is an independent predictor of many adverse outcomes of pregnancy, the IOM recommends that women begin pregnancy with a normal BMI.

Prevalence and Burden of Disease/Illness

Obesity and Overweight in Pregnancy

The prevalence of overweight and obesity is increasing among women of childbearing age and pregnant women, similar to trends observed in nonpregnant populations. Based on the 2015-2016 National Health and Nutrition Examination Survey, the estimated prevalence of obesity was 36 percent among women ages 20 to 39 years.[4] Data suggests that obesity rates during pregnancy in the United States increased from 13 percent in 1993 to 24 percent in 2015.[5] In 2015, it was estimated that almost half of all women entered pregnancy with overweight or obesity (24% with

obesity and 24% with overweight).[6] Reported rates of overweight and obesity are generally higher among non-Hispanic black, Alaska Native/American Indian, and Hispanic women, and lower among non-Hispanic white and Asian women.[7]

Since the IOM 2009 recommendations, observational studies have continued to report strong associations between elevated prepregnancy BMI and adverse pregnancy outcomes.[8-16] A 2017 review of 156 meta-analyses of cohort studies[8] found that elevated prepregnancy BMI was associated with increased risk of cesarean delivery, antenatal depression, gestational diabetes mellitus (GDM), large for gestational age (LGA), macrosomia, stillbirth, postpartum hemorrhage, and preterm birth, and that the association was stronger for those with increasing degrees of maternal obesity.[17] Most recently, the LifeCycle Project-Maternal Obesity and Childhood Outcomes Study Group conducted an individual participant-level meta-analysis using data from over 196,000 singleton pregnancies within 25 cohort studies from Europe and North America. Prepregnancy BMI was the strongest risk factor associated with adverse maternal and infant outcomes including preeclampsia, gestational hypertension, gestational diabetes, cesarean delivery, preterm birth, and small for gestational age (SGA) or LGA, and was a stronger risk factor than GWG.[18] Observational data also support associations between women with underweight BMI prior to pregnancy and increased risk of preterm birth.[19,20] However, there are less data to support whether change in weight before pregnancy is associated with a change in perinatal outcomes.

Excess Gestational Weight Gain

Observational studies have examined the association between health outcomes as they relate to GWG above and below the 2009 IOM guidelines. Excessive GWG, defined as weight gain above that recommended by the IOM in any category, has been associated with lower risk of SGA and preterm birth, but higher risk of LGA and higher risk of cesarean delivery.[21,22] GWG below recommended IOM guidelines has been associated with higher risk of SGA and preterm birth, but lower risk of LGA and macrosomia, and no difference in cesarean delivery.[22]

In 2009, the IOM committee determined that the maternal health outcomes most closely associated with GWG were postpartum weight retention, cesarean delivery, GDM, and pregnancy-induced hypertension or preeclampsia.[23] However, there was insufficient evidence to determine a causal link between risk of preeclampsia or GDM. For infant outcomes, measures of infant size at birth (e.g., SGA and LGA), preterm birth, and childhood obesity were most strongly associated with GWG.[24]

In 2015, GWG was within the recommended IOM guideline range for 32 percent of women in any BMI category giving birth to full-term, singleton infants; 48 percent gained more weight and 21 percent gained less weight than recommended in the IOM guidelines. Weight gain above IOM recommendations was highest among women who were overweight (61%) or had obesity (55%) before pregnancy.[25] The association between race and ethnicity and likelihood of adhering to IOM guidelines is not clear, although the association tends to vary by baseline BMI.[26,27]

Etiology and Natural History

The etiologic factors that contribute to higher BMI before pregnancy are similar to factors that contribute to overweight and obesity in nonpregnant persons. The combination of individual factors (e.g., genetics, health behaviors, dietary patterns, physical activity, comorbid illnesses) and societal factors (e.g., environment, education and skills, food marketing and promotion) interact to produce weight gain, including an increase in body weight prior to pregnancy.[28] However, unlike the nonpregnant adult state, weight gain during pregnancy can be attributed to both the fetal compartment (fetus, placenta, amniotic fluid) and the maternal compartment, including increased maternal blood volume, uterus and breast tissue, extracellular fluid, and fat accumulation.[29] When maternal fat mass accrual is excessive, it may also be associated with adverse metabolic consequences during pregnancy.[24,30,31]

Entering pregnancy at an elevated BMI or gaining excessive fat during pregnancy can be associated with metabolic dysfunction (e.g., hyperinsulinemia, inflammation, oxidative stress) and may negatively affect organogenesis, metabolic programming, maternal adipose tissue deposition and expansion, and placenta development. These effects can result in a metabolically dysregulated intrauterine environment, leading to placental and fetal dysfunction throughout pregnancy.[32-41] The Developmental Origins of Health and Disease hypothesizes that the events that occur during the earliest stages of human development may influence the development of diabetes, cardiovascular disease, asthma, cancers, osteoporosis, and neuropsychiatric disorders later in life.[42-45]

Interventions/Treatment

Preconception care for women with overweight or obesity may include counseling related to the risks of obesity in pregnancy and weight-loss interventions prior to conception. Given that nearly half of pregnancies in the United States are unplanned,[46] the window for preconception counseling to optimize prepregnancy BMI often is unclear. Efforts to assess pregnancy intention may provide additional opportunities to address or reduce these risks.[47] For pregnant women, interventions to reduce excess GWG may include one or more of the following: patient education and/or counseling related to potential adverse effects of excess GWG, behavioral counseling related to healthy diet or physical activity (or both), referral to nutrition services, or referral to a structured exercise program to help prevent excessive weight gain. The intensity, duration, and frequency of GWG interventions vary. Weight loss medications are not recommended for use in women planning pregnancy or during pregnancy due to safety concerns and adverse effects.[48] Although bariatric surgery may be considered treatment for weight loss in reproductive age women considering a future pregnancy, the timing of pregnancy in relation to bariatric surgery is controversial; pregnancy is generally not recommended until weight loss has stabilized in women who have undergone surgery (at least 12 to 24 months).[49-51]

Current Clinical Practice/Recommendations of Other Groups

Current guidelines emphasize the importance of preconception counseling and weight loss for women with overweight or obesity. The American College of Obstetricians and Gynecologists

recommends that primary health care providers of women of reproductive age with obesity provide specific information regarding the maternal and fetal risks of obesity in pregnancy and provide resources or encourage women to undertake a weight-reduction program before conceiving, including access to contraception to help them achieve a healthy weight prior to conception.[1,48,52-55] Numerous organizations and clinical guidelines, including those from the IOM and National Institutes of Health (NIH), recommend counseling about healthy weight gain during pregnancy, adherence to IOM recommendations about GWG, and/or providing women at risk of excess GWG with lifestyle interventions (**Table 1**).[53] Guidelines also note that abnormally high or low BMI is associated with infertility and pregnancy complications. In response to these recommendations, there has been a proliferation of randomized clinical trials on the effect of interventions on GWG published in the last decade.[56-60]

Standard prenatal care usually includes weight monitoring to identify inadequate or excessive gestational weight. However, the degree to which women with overweight and obesity receive recommended preconception counseling or referrals to interventions is unclear.[61,62] Women also report receiving conflicting information among different health care providers. A 2018 review of 54 articles documenting GWG discussions between women and their providers found variable prevalence and content of GWG counseling, although rates of counseling were often reported to be low and the content inaccurate. A newer systematic review reported a high percentage of women receiving advice on GWG, but the accuracy of the advice was less than optimal.[63] Factors associated with receipt of GWG advice include being a woman with higher socioeconomic status, older age, nulliparity, a history of dieting, low physical activity, and having overweight or obesity.[64]

Chapter 2. Methods

Key Questions and Analytic Framework

Using methods developed by the USPSTF,[65] the Evidence-based Practice Center (EPC) developed the scope and Key Questions in collaboration with the USPSTF and Agency for Healthcare Research and Quality (AHRQ).[65] Investigators created an analytic framework with the key questions and the patient populations, interventions, outcomes, and adverse effects reviewed (**Figure 1**). The research plan was externally reviewed and modified prior to finalization.

Key Questions

This review addresses three Key Questions on the effects of counseling and active behavioral interventions on healthy weight and weight gain during pregnancy**.** The populations addressed were pregnant women with normal and high BMI and women with overweight and obesity planning a pregnancy, including adolescents.

Key Questions

1a. Do interventions to limit excess gestational weight gain improve health outcomes among pregnant women and their infants?
1b. Do interventions to reduce prepregnancy weight in women who are overweight or obese improve health outcomes among women who become pregnant and their infants?
1c. Does the effectiveness of these interventions differ by age, race/ethnicity, socioeconomic status, parity, smoking status, or body mass index (BMI) category?
2a. Do interventions to limit excess gestational weight gain reduce gestational weight gain, postpartum weight retention, or obesity-related adverse perinatal conditions among pregnant women and their infants?
2b. Do interventions to reduce prepregnancy weight in women who are overweight or obese improve weight outcomes or reduce obesity-related adverse perinatal conditions among women who become pregnant and their infants?
2c. Does the effectiveness of these interventions differ by age, race/ethnicity, socioeconomic status, parity, smoking status, or body mass index (BMI) category?
3a. What are the harms of interventions to limit excess gestational weight gain among pregnant women and their infants?
3b. What are the harms of interventions to reduce prepregnancy weight among women or who are overweight or obese?
3c. Do the harms of these interventions differ by age, race/ethnicity, socioeconomic status, parity, smoking status, or BMI category?

Key Question 1 focuses on the effect of interventions to limit excess gestational weight gain or reduce prepregnancy weight on health outcomes (i.e., maternal or infant morbidity and

mortality). Key Question 2 evaluates the effect of interventions on weight outcomes (i.e., weight loss or gain, excessive gestational weight gain based on IOM recommendations, preconception weight loss, and postpartum weight loss or retention). Key Question 3 examines the harms of these interventions.

Contextual Questions

Contextual Questions were also requested by the USPSTF to help inform the report. Contextual Questions are not reviewed using systematic review methodology.

1. What is the association between gestational weight gain and adverse maternal and infant outcomes?
2. What is the association between high prepregnancy BMI and risk of adverse maternal and infant outcomes?
3. Among women with a high prepregnancy BMI, what is the association between reduction in prepregnancy weight and risk of adverse maternal and infant outcomes?

Search Strategies

We searched the Cochrane Database of Systematic Reviews (2005 through March 20, 2020), Cochrane Central Register of Controlled Trials, PsychINFO, Ovid MEDLINE In-Process & Other Non-Indexed Citations (through March 20, 2020), and Ovid MEDLINE (1946 through March 20, 2020) for relevant English-language studies and systematic reviews. Search strategies are available in **Appendix A1.** Electronic searches were supplemented by review of reference lists of relevant articles and studies meeting inclusion criteria, as well as articles identified through news and table-of-content alerts such as those produced by the USPSTF Scientific Resource Center LitWatch activity. The last surveillance was conducted on August 31, 2020, and two additional trials have recently been published, showing no difference in gestational weight gain in e-health lifestyle interventions.[66,67]

Study Selection

Two reviewers independently evaluated each study to determine inclusion based on predetermined eligibility criteria developed for each Key Question (**Appendix A2**). After an initial dual review of citations and abstracts, investigators retrieved full-text articles of potentially relevant material. Two reviewers conducted full-text review of articles; discrepancies were resolved through consensus or with input from a third reviewer. The selection of literature is summarized in the literature flow diagram (**Appendix A3**). **Appendix A4** lists the included studies, and **Appendix A5** lists excluded studies with reasons for exclusion.

The target population was women, including adolescents, who were pregnant with normal or high BMI, or who were overweight or obese and planning pregnancy. Women with low prepregnancy BMI (underweight) were outside the scope of this review. This review focused on

interventions conducted in, or recruiting from, primary care or primary care-referable settings, including routine prenatal care settings. Broader, community-based interventions were excluded. Pharmacologic interventions were excluded because they are not recommended in pregnancy.

Interventions were classified as either *counseling-only* or *active* behavioral interventions. Counseling-only interventions consisted of advice provided during the course of an intervention without an active component. Active interventions consisted of a structured, physical element and could include a counseling component. Active interventions included supervised exercise programs, prescribed exercise or dietary programs, or intensive weight management. The intensity of interventions varied with regard to the number of sessions or contacts, the duration and frequency of sessions, and the length of treatment. Intervention intensity was defined by the number of participant contacts beyond usual care or the comparison group, and was categorized as low (fewer than 2 contacts during the intervention period), moderate (3-11 contacts), or high intensity (12 or more contacts). Comparisons were behavioral interventions versus a control (i.e., usual care, attention control, minimal intervention). Minimal interventions (e.g., generic print materials) and attention controls (i.e., similar format but different content than intervention) commonly consisted of initial sessions with a provider regarding general education on healthy behavior in pregnancy, group education on general health topics, or access to websites promoting healthy behaviors during pregnancy. In some trials, usual care could include nutrition or physical activity materials based on national guidelines or access to additional support (e.g., access to midwives) as needed.

Outcomes were classified as weight-related intermediate outcomes (GWG, exceeding IOM recommendations for GWG, adherence to IOM recommendations for GWG, and postpartum weight loss or retention) or health outcomes. Women were defined as exceeding IOM recommendations if they had normal BMI and gained more than 35 lbs., overweight and gained more than 25 lbs., or obesity and gained more than 20 lbs. Adherence to IOM recommendations was defined as neither gaining excessive weight nor failing to gain sufficient weight according to IOM recommendations by BMI category. Maternal health outcomes included maternal mortality, maternal morbidity (i.e., postpartum hemorrhage, perineal trauma, depression), and health outcomes (i.e., gestational diabetes, gestational hypertension, preeclampsia, cesarean delivery). For studies of gestational diabetes, diagnostic criteria varied and included methods such as use of the International Association of Diabetes and Pregnancy Study Group (IADPSG) criteria that used the 1-step approach to diagnosis with a 75 g glucose load, country-specific guidelines as defined by national criteria, or diagnosis per chart review with no specific criteria reported. Gestational hypertension was defined as systolic blood pressure of 140 millimeters of mercury [mm Hg] or higher, or a diastolic blood pressure of 90 mm Hg or higher after 20 weeks of gestation in a woman with previously normal blood pressure. Studies reporting the standard definition of gestational hypertension (two measurements of greater than 140/90 mm Hg at least 4 hours apart) were also included.[68] Preeclampsia was defined as gestational hypertension accompanied by one or more new-onset systemic abnormalities (i.e., new-onset proteinuria greater than 300 mg/24 hours, protein/creatinine ratio of greater than or equal to 0.3, or dipstick reading of 1+, disturbances in hematologic, liver, renal, or visual symptoms, edema).[68] Some studies did not provide a formal definition of preeclampsia but reported the outcome categorically. Infant health outcomes included infant mortality (including stillbirth), infant morbidity (i.e., birth trauma, shoulder dystocia, respiratory distress syndrome), and infant health

outcomes (i.e., macrosomia, large for gestational age, preterm birth, growth during first year of life). Macrosomia was defined as term infants weighing more than 4,000 g, while large for gestational age was defined as birthweight above the 90th percentile for gestational age. Preterm birth included infants born before 37 weeks gestation, before 36 weeks, or were defined categorically. Harms were those associated with interventions (e.g., anxiety, depression, maternal musculoskeletal injuries, stigma, and harms related to insufficient weight gain, including small for gestational age). Small for gestational age was defined as birthweight below the 10th percentile for gestational age. Studies reporting only behavioral changes or intermediate cardio-metabolic measures were excluded.

Studies conducted in countries rated "very high" on the 2016 Human Development Index (considered applicable to U.S. populations and primary or prenatal care practice) were included.[69] For all Key Questions, only randomized and nonrandomized controlled clinical trials that focused on diet, exercise, and/or behavioral counseling were included; cohort or case-control studies reporting harms (Key Question 3) were also eligible for inclusion.

Inclusion was restricted to English-language articles. Other exclusion criteria were studies published only as abstracts, non-systematic literature reviews, editorials or other opinion letters, and research protocols. Studies of nonhuman subjects were excluded, and studies had to report original data. Articles reporting overall consortium results, including trials that have not yet been published individually, were excluded.

Data Abstraction and Quality Rating

For studies meeting inclusion criteria, we created data abstraction forms to summarize characteristics of each study. One investigator abstracted details about the study design, patient population, setting, interventions, analysis, followup, and results (**Appendix B Tables 1-3**). A second investigator reviewed data abstraction for accuracy. Two investigators independently applied predefined criteria developed by the USPSTF (**Appendix A6**) to assess the quality of individual controlled trials, systematic reviews, and observational studies and rate them as "good," "fair," or "poor," depending on the seriousness of the methodological shortcomings.[65] Discrepancies were resolved by consensus. Studies that were rated poor quality were excluded because results are more likely to be biased and highly unreliable.[65]

Data Synthesis

To summarize evidence on the effects of GWG interventions, data were synthesized separately for each Key Question by outcome, including weight-related outcomes and health outcomes. Only randomized controlled trials were considered for meta-analysis. For both continuous and dichotomous outcomes, a random effects model based on the profile likelihood method was used to combine trials that evaluated comparable populations and interventions. Random effects meta-analyses were performed in STATA version 14 (Stata Corp, College Station, TX).

For continuous outcomes (GWG and postpartum weight retention), meta-analysis was conducted to combine the mean difference between the intervention and the control groups. If a study reported mean difference adjusted for baseline characteristics, the adjusted mean difference was used in the meta-analysis; otherwise, the difference in weight change from baseline to followup was used as the measure for mean difference. As imbalance in baseline weight was generally not observed in studies, sensitivity analysis was not conducted using the difference in followup weights. If weight change was not reported but baseline and followup weights were reported, the weight change was calculated based on these data points, and the correlation between baseline and followup weights was assumed to be the average correlation calculated from studies that reported all standard deviations (SD) from baseline, followup weights, and weight changes. Missing SDs were imputed, if necessary, by assuming the same coefficient of variation at baseline and followup; the SDs at baseline and followup were similar in studies that reported both.

For dichotomous outcomes with at least five trials, sufficient sample size, and comparable outcomes (GDM, gestational hypertension, preeclampsia, cesarean delivery, postpartum hemorrhage, perineal trauma, macrosomia, preterm birth, LGA, SGA, respiratory distress syndrome, shoulder dystocia, neonatal intensive care unit [NICU] admission, and exceeding or adhering to IOM recommendations for GWG), risk ratios were combined across eligible studies. Data were also pooled for 13 trials that reported emergency cesarean as separate, and clinically distinct, events; the other studies of cesarean did not provide separate data or descriptions. Results from arms of comparable interventions and outcome definitions within the same study were combined so each study was represented only once in each meta-analysis.

Stratified analyses were conducted when sufficient data were available to evaluate subgroup effects based on BMI category (normal, overweight, obese, overweight or obese combined, or mixed BMI populations), weight assessment time point (28 weeks, 34-36 weeks, 36 weeks up to delivery, and at delivery), intervention type (counseling-only or active) and intensity (low, moderate, or high, as defined in the Study Selection section), and study quality (good or fair). One study could contribute data for more than one subgroup in stratified analyses. We assessed statistical heterogeneity with the Cochran Q-test and the I^2 statistic, which assesses the percentage of variation across studies that is due to heterogeneity rather than chance.[70] The p-value for subgroup interaction was calculated to test for subgroup differences.

For all Key Questions, the overall quality of evidence was determined using the approach described in the USPSTF Procedure Manual.[65] We assessed the aggregate internal validity (quality) of the overall body of evidence for each Key Question (insufficient, low, moderate, and high) using methods developed by the USPSTF, based on the number, quality, and size of studies, consistency of results between studies, and directness of evidence.[65] A summary of evidence table was developed to assess the overall quality of evidence for each Key Question using the approach described in the USPSTF Procedure Manual.[65]

Expert Review and Public Comment

A draft research plan for this topic was posted on the USPSTF Web site for public comment from April 26th through May 3rd, 2018. The USPSTF received minor comments related to the included populations and outcomes. In response to these comments, the USPSTF added parity and smoking status to the included subpopulations for Key Questions (KQ) 1c, 2c, and 3c. In addition, the USPSTF revised the list of eligible outcomes for KQ 1 to clarify that stillbirth, depression, and shoulder dystocia are included. Finally, the USPSTF revised the list of eligible outcomes for KQ 3 to clarify that harms related to insufficient weight gain among infants were included. A final version of the research plan was posted on the USPSTF website in July 2019. A draft version of this report was reviewed by content experts (**Appendix A7**), representatives of Federal partners, USPSTF members, and AHRQ Medical Officers. Reviewer comments were presented to the USPSTF during its deliberations and have been incorporated into the draft report. Additionally, this draft report will be posted for public comment and revised accordingly.

Chapter 3. Results

Included Studies

Our literature search resulted in 8,431 unique citations. Following dual title and abstract review and dual evaluation of 816 full-text articles, we identified 68 trials of interventions to limit excess GWG, reported in 87 publications that addressed Key Questions 1-3.[56,58,59,71-154] Of the 576 articles that were excluded at the full text level, the most common reasons for exclusion were: publication type other than an original peer-reviewed study (i.e., conference abstracts or literature reviews) (161 articles), study design outside the scope of the review (i.e., not trials) (109 articles), wrong outcome (96 articles), or wrong intervention (61 articles). Eight studies[155-162] were excluded at the full-text level due to poor quality.

The search and selection of articles, including reasons for exclusion (**Appendix A5**), are summarized in the literature flow diagram (**Appendix A3**).

Study Characteristics

Of the 68 included studies, 64 were randomized controlled clinical trials (RCTs) [56,58,59,71-86,88-92,94,96-99,101-119,121-154] and four were controlled clinical trials (CCTs)[87,93,100,120] (**Appendix B Table 1**). All studies included pregnant women. Sixty-seven trials evaluated interventions during pregnancy, one evaluated a prepregnancy intervention,[116] and one study included a preconception component;[137] however, no other studies evaluated the effectiveness of prepregnancy interventions to limit excessive GWG in women prior to pregnancy, limiting the number of studies to address Part B of any Key Question.

All studies conducted during pregnancy reported at least one maternal outcome: GWG (all studies), weight gain according to IOM recommendations (19 trials),[59,75,81,84,89,92,99,119,123,125,126,128,131,135,138,142,143,148,150] cesarean delivery (48 studies),[56,58,59,72,74-76,78,80-86,89,90,92,94,98,100,101,108,110,111,114,115,119-126,128,130-132,136,138,139,141,143,148-150,154] GDM (45 studies),[56,58,59,72,76,78,80-86,89,90,92,97,100,101,104,108,110,111,114,115,117,119-121,123,124,126,128,130-132,136-139,141,142,149,150] gestational hypertension (29 studies),[56,58,59,76,80,83-86,92,97,114,115,119-123,126,128,130,131,136-138,141,148,150,154] preeclampsia (28 studies),[56,58,59,72,76,80,83,84,89,92,101,114,115,117,119-123,128,130,131,136,137,139,141,148,154] postpartum weight retention (14 studies),[74,90,96,100,102,103,105,109,115,127-129,131-133,140,151,154] postpartum hemorrhage (10 studies),[56,72,84,92,101,119,120,123,139,141] perineal trauma (8 studies),[56,76,84,92,98,119,139,141] maternal depression and anxiety (12 studies),[71,83,87-89,92,93,95,101,121,125,143] or maternal mortality (2 studies).[84,119] Fifty studies (in 67 publications)[56,58,59,72,74,76,77,79-82,84-86,89-92,94,100,101,108,110,111,114,115,117,121-124,126-128,130-133,136-139,141-143,147-150] also reported at least one infant outcome, including preterm birth (35 studies),[56,58,72,74,77,79-82,85,86,89,91,92,94,97,101,107,108,115,121,122,126-128,130-133,136,138,139,141,143,147-151] macrosomia (27 studies),[56,58,59,74,76,77,79,80,82,84,85,91,92,97,98,100,112-115,117,124,127,128,130,131,138,141,145,146,148,150-152] LGA (27 studies),[56,58,59,72,76,85,86,90-92,94,101,107,108,110,111,113,115,117,121,123,132,133,136,139,141,142,145,146,148-152] SGA and low birth weight (30 studies),[72,76,85,86,90,92,94,101,107,108,113,115,117,121,123,132,133,139-142,148-151] NICU admission (15

studies),[56,59,72,84-86,89-92,97,98,101,121,123,139-141,145,146,150-152] infant respiratory distress syndrome (8 studies),[76,84-86,114,136,137,141,150,151] shoulder dystocia (8 studies),[56,76,84,89,92,119,123,139] and neonatal mortality (11 studies)[59,72,84-86,89,92,121,139-141,145,146,152] (**Appendix B Table 3**).

Across all studies, sample sizes ranged from 50 to 2,261 (N=25,463; median n=230), and studies enrolled women aged 18 years and older; reported sample mean ages ranged from 18.6 years to 33.8 years (median 30.4 years, SD 2.8), with enrolled study participants ranging in age from 14 to 49 years depending on study inclusion criteria (**Appendix B Table 1**). There were no studies exclusively of pregnant adolescents or women with advanced maternal age. Thirty-four trials[58,59,71,72,74,76,78-83,85,87-90,96-98,102,109,112-115,117,120,124-126,132,133,135-140,142,145,146,152,154] were conducted in Europe, 22 trials[73,75,86,93,94,99,100,103,106-108,110,111,118,122,123,127-131,134,144,147-151] in the United States and Canada, 10 trials[56,84,91,92,101,104,105,119,121,141,143,153] in Australia and New Zealand, and 1 trial[77] in Argentina. Studies did not report outcomes by age, race and ethnicity, socioeconomic status, parity, or smoking status.

Studies included women in three prepregnancy BMI categories: mixed (all BMI categories), overweight and obesity only, and obesity only. One study enrolled pregnant women with normal weight only[92]; 34 studies[71,72,74-82,84,89,99-102,109-111,115,118,122,124,127,128,131-133,135,138,139,143,144,147,148] enrolled pregnant women of mixed weight categories (including 1 trial[88] enrolling women with normal weight and overweight only); 19 studies[56,73,85,86,91,93,94,96-98,103-108,113,117,119,123,125,126,129,130,134,141,149,153] enrolled women with overweight or obesity only; and 13 studies[58,59,83,87,90,114,120,121,136,137,142,145,146,150-152,154] enrolled women with obesity only (**Appendix B Table 1**). The majority of trials recruited women directly from the primary care setting, including obstetric and prenatal care settings, at the initial prenatal visit or through electronic health records. Eight studies recruited participants more widely via newspaper or online advertisements, referrals from social services, health fairs, or flyers posted in community spaces.[97,99,102,111,114,122,144,148]

Sixty-seven trials evaluated interventions during pregnancy; six included interventions continuing into postpartum period.[74,93,103,115,122,147] Forty-five studies (in 56 publications)[56,58,72-76,83-86,88,89,91-94,100,103-109,112-115,117-123,126-128,131-137,142-144,147-151,153,154] evaluated counseling-only interventions, where providers either offered advice or specific recommendations on behavior change (e.g., weight monitoring, dietary changes, physical activity); 22 studies (in 29 publications)[59,71,77-82,87,90,96-99,101,102,110,111,124,125,129,130,138-141,145,146,152] were considered active interventions where providers implemented a structured, physical element such as medically supervised exercise or meal replacement (**Appendix B Tables 1-2;** see **Appendix E Table 2** for examples of implementation). Interventions addressed advice about nutrition (5 studies),[72,76,119,123,154] physical activity (16 studies),[71,77,78,80-82,90,96-98,101,102,125,135,138,141,144] lifestyle and behavioral change (6 studies),[93,104-108,118,121] or serial weight measurement (3 studies),[84,88,89] with the remainder addressing multiple components (**Appendix B Table 2**). The interventions were highly variable in intensity (number of sessions or contacts) and modes of delivery (**Appendix B Table 1**). Ten trials[75,76,84,88,89,119,126,131-133,135] were considered low intensity (fewer than 2 contacts during the intervention period); 23 trials[56,72,74,83,85,91,92,100,104-106,109,112-115,117,118,120,122,123,127,128,136,137,142-144,154] evaluated moderate-intensity interventions (3-11 contacts); and 34 trials[58,59,71,73,77-82,86,87,90,93,94,96-99,101-103,107,108,110,111,121,124,125,129,130,134,138-141,145-153] evaluated high-intensity interventions (12 or more contacts). Moderate and high-intensity interventions

included the potential to refer participants to external providers (e.g., registered dieticians, qualified fitness specialists, physiotherapists, health coaches, etc., not embedded in the research team) and/or settings (e.g., local community fitness center). Interventions evaluated in the nine low-intensity trials included healthy behavior counseling at an initial session with a dietician, midwife, or other provider, followed by tailored counseling on iterative weight gain during regularly scheduled visits. In five trials, research team and external providers also made specific recommendations for supervised physical activity based on ACOG guidelines.[75,76,131-133,135] The 57 moderate-[56,72,74,83,85,91,92,100,104-106,109,112-115,117,118,120,122,123,127,128,136,137,142-144,154] or high-[58,59,71,73,77-82,86,87,90,93,94,96-99,101-103,107,108,110,111,121,124,125,129,130,134,138-141,145-153] intensity trials included interactions with participants in person, by telephone, or both, and generally included individual or group education or counseling on healthy diet and exercise, or medically supervised group exercise classes with or without counseling for those characterized as active interventions.

The mode of delivery for the interventions was primarily face-to-face in 59 studies and by computer, internet, or telephone in 5 trials[107,108,122,144,149,153]; 3 trials[58,73,134] compared a face-to-face arm and a telehealth arm with a control group (**Appendix B Tables 1-2**).

The comparison, or control intervention, consisted of usual care in 56 trials and minimal intervention in 11 trials (**Appendix B Table 2**).[59,85,86,94,99,104,122,144,148,149] Minimal intervention or attention controls typically included general education sessions on healthy behaviors in pregnancy; in three trials[86,121,148] evaluating a peer-educator program, control participants received home visits and group education. Usual care involved routine antenatal care with obstetricians, midwives, or other providers and included information on healthy pregnancy behaviors delivered by clinic staff or via printed information; the intensity, frequency, and content of usual care varied according to standards in the country where the intervention occurred.

The timing of initiation and study duration varied across trials, with the initial intervention generally occurring at the end of the first trimester or the beginning of the second trimester, and generally ending prior to delivery. For the outcome of total GWG, the timing and evaluation of weight gain assessments differed across trials, with one trial assessing final weight at 28 weeks, 18 trials at 34-36 weeks, 27 trials at 36 weeks up to delivery, 19 trials at delivery, one trial at 2 weeks postpartum, and one trial did not report timing (**Appendix B Table 3**). The followup period for the majority of studies ended at the time of the final weight measurement; however, 14 trials followed participants postpartum and reported the outcome of postpartum weight retention at various timepoints, specifically within 6 months of delivery[96,100,102,105,107,109,112,128,131,132,152,154] and at 12 months postpartum[74,103,107,109,112,127,129,133,140,151] (**Appendix B Table 3**).

Given the overlap of studies included for more than one Key Question and the limited trials on prepregnancy weight loss interventions, results are organized by outcome into the following sections: maternal health outcomes, infant health outcomes, prepregnancy weight loss, maternal weight outcomes, and harms (**Appendix B Table 3**). Data regarding subgroup effects were primarily available for BMI categories and are reported within the results for each outcome.

Study Quality

Among the 68 included studies, 15 RCTs[56,58,74,76,86,91,92,104,105,113,116,117,121,125,139,141,142,150,151] and 1 CCT[93] were rated good-quality, and 49 RCTs and 3 CCTs[59,71-73,75,77-85,87-90,94,97,99-103,106-112,114,115,118-120,122-124,126-138,143-149,152-154] were rated fair-quality (**Appendix C Tables 1-2**). Methodological limitations in the fair-quality trials included lack of reporting details about blinding of care providers[56,58,59,74-81,83-89,91,92,94,97-100,102,106-108,110-114,117-120,122-128,130-135,138-140,142-146,148,150-154] or outcome assessors or analysts,[58,59,75,77-81,83,84,87,88,100,106-108,110-114,117,120,122-126,131-133,135,144-146,148,152-154] relatively higher (i.e., greater than 20%) and differential attrition,[77,85,87,90,102,110,118,122,135,143,154] lack of or unclear reporting of allocation concealment,[92,106,110,111,122,124,131,138,148,154] no attempt to or did not report on intention-to-treat analyses,[59,110,119,124,144-146,152] and significant differences in groups at baseline.[88,120,132,133,153] The main limitations for the eight poor-quality intervention studies were multiple or very serious flaws in the domains of attrition,[155-162] lack of reporting details of blinding of outcome assessors or analysts,[155-161] significant differences between groups at baseline,[156-161] or lack of reporting methods of randomization.[156-158]

Effects of Interventions to Limit Excess Gestational Weight Gain on Maternal Health Outcomes

Summary

- GWG interventions were associated with decreased risk of GDM versus controls (43 trials; RR, 0.87 [95% CI, 0.79 to 0.95]; I^2=16.4%; ARD, -1.6% [95% CI, -2.5 to -0.7]); there were no statistically significant interactions between effects of GWG intervention on rates of GDM and BMI category (p=0.14 for interaction), intervention type (p=0.68 for interaction), or intervention intensity (p=0.92 for interaction).
- GWG interventions were associated with decreased risk of emergency cesarean delivery, but indications were rarely reported (13 trials; RR, 0.87 [95% CI, 0.75 to 0.98]; I^2=0.0%; ARD, -2.2% [95% CI, -4.0 to 0.0]).
- GWG interventions were not associated with risk of gestational hypertension (28 trials; RR, 0.87 [95% CI, 0.70 to 1.04]; I^2=32.5%; ARD, -0.8% [95% CI, -1.9 to 0.2]); cesarean delivery (34 trials; RR, 0.98 [95% CI, 0.91 to 1.04], I^2=10.8%; ARD, -0.7%, [95% CI, -2.4 to 0.8]), preeclampsia (27 trials; RR, 0.98 [95% CI, 0.84 to 1.13]; I^2=0.0%; ARD, 0.1% [95% CI, -0.6 to 0.5]), postpartum hemorrhage (9 trials; RR, 1.00 [95% CI, 0.88 to 1.15]; I^2=0.0%; ARD, -0.1% [95% CI, -1.3 to 1.5]) or perineal trauma (third- or fourth-degree perineal tear, 8 trials; RR, 0.86 [95% CI, 0.52 to 1.50]; I^2=57.0%; ARD, -0.7% [95% CI, -3.2 to 1.7]) versus controls.
- Statistically significant interactions between effects of GWG interventions on perineal trauma and BMI category and intervention intensity were present, and between effects of GWG interventions on gestational hypertension and intervention intensity and active interventions.
- Evidence was too limited to determine effects of GWG interventions on maternal mortality.

Evidence

Gestational Diabetes Mellitus

Forty-two trials (43 RCTs and 2 CCTs; N=20,758) of counseling-only and active interventions versus controls reported on the outcome of GDM (**Appendix B Tables 1-3**).[56,58,59,72,76,78,80-86,89,90,92,97,100,101,104,108,110,111,114,115,117,119-124,126,128,130-132,136-139,141,142,149,150,154] Twelve trials were rated good quality[56,58,76,86,92,104,117,121,139,141,142,150] and 33 trials were rated fair quality (**Appendix C Tables 1-2**). The criteria used to define GDM varied among studies and included criteria based on country-specific guidelines (16 studies);[56,58,59,81,83,100,101,110,111,114,117,119,124,132,139,154] IADPSG criteria using the 1-step approach to diagnosis with a 75 g glucose load (18 trials),[72,76,82,85,86,90,92,97,104,115,121,126,130,136,137,141,142,149] and review of medical records (9 studies)[80,89,120,122,123,128,131,138,150]; two trials used unclear criteria to define GDM.[78,84] Forty-two trials reported timing of screening, which occurred between 24 to 28 weeks' gestation in all trials; one trial[137] also screened for GDM at 12 to 16 weeks. One trial[92] enrolled women with normal BMI, 20 trials enrolled women in mixed prepregnancy BMI categories,[72,76,78,80-82,84,89,101,110,111,114,115,117,122,124,131,132,138,139] 12 studies included women categorized only as obese (BMI greater than 29[83,142] or greater than or equal to 30[58,59,90,120,121,136,137,150,154] kg/m^2), and 12 studies included women in overweight or obese categories.[56,85,86,97,100,104,108,119,123,126,128,130,141,149] There were 31 studies of counseling-only interventions,[56,58,72,76,83-86,89,92,100,104,108,114,115,117,119-123,126,128,130-132,136,137,142,149,150,154] and 15 trials that included an active component.[78,80-82,90,98,101,124,138,141] Intervention intensity was low in 7 trials,[76,84,89,119,126,131,132] moderate in 17 studies,[56,72,83,85,92,100,104,114,115,117,120,122,123,128,136,137,142,154] and high in 21 trials.[58,59,78,80-82,86,90,97,101,108,110,111,121,124,130,138,139,141,149,150]

GWG interventions were associated with decreased risk of GDM versus control (43 trials; RR, 0.87 [95% CI, 0.79 to 0.95]; I^2=16.4%; ARD, -1.6% [95% CI, -2.5 to -0.7]) (**Table 2, Figure 2**). In the stratified analyses, there were no subgroup interactions between rates of GDM and BMI category (p=0.14 for interaction), intervention type (p=0.68 for interaction), or intervention intensity (p=0.92 for interaction; **Table 2**).

Gestational Hypertension

Twenty-eight RCTs and one CCT[120] (N=16,489) reported rates of gestational hypertension (**Appendix B Tables 1-3**).[56,58,59,76,80,83-86,92,97,114,115,119-123,126,128,130,131,136-138,141,148,150,154] Eight RCTs were rated good quality[56,58,76,86,92,121,141,150] and 20 RCTs and one CCT[120] fair quality[59,80,83-85,97,114,115,119,122,123,126,128,130,131,136-138,148,154] (**Appendix C Tables 1-2**). Gestational hypertension was defined as persistent or repeated measures of blood pressure greater than or equal to 140/90 mmHg after 20 weeks' gestation, and was generally consistent with the U.S. guideline defined by two measurements of elevated blood pressure (greater than or equal to 140/90 mmHg) at least 4 hours apart.[68]

There were 9 trials enrolling women with mixed prepregnancy weight,[76,80,84,115,122,128,131,138,148] 9 trials with prepregnancy overweight or obesity,[56,85,86,97,119,123,126,130,141] and 10 trials of women with obesity.[58,59,83,114,120,121,136,137,150,154] Six trials reported the effects of interventions in women

with normal prepregnancy BMI.[80,92,122,128,131,138] Seven trials evaluated active exercise interventions[59,80,97,123,130,138,141] while the remaining studies evaluated counseling-only interventions. The intensity of interventions was low in 5 trials,[76,84,119,126,131] moderate in 13 trials,[56,83,85,92,114,115,120,122,123,128,136,137,154] and high in 11 trials.[58,59,80,86,97,121,130,138,141,148,150]

GWG interventions were not associated with reduced likelihood of gestational hypertension compared to controls (28 trials; RR, 0.87 [95% CI, 0.70 to 1.04]; I^2=32.5%; ARD, -0.8%, [95% CI, -1.9 to 0.2]) (**Table 3, Figure 3**).[56,58,59,76,80,83-86,97,114,115,119,121-123,126,128,130,131,136-138,141,150,154] However, stratified analysis demonstrated statistically significant interactions between effects of GWG interventions on gestational hypertension and active interventions (p<0.001 for interaction) and high intensity interventions (p=0.006 for interaction), but not BMI category (p=0.08 for interaction; **Table 3**).

Cesarean Delivery

Forty-eight studies (N=19,970) reported effects of GWG interventions on rates of cesarean delivery (**Appendix B Tables 1-3**).[56,58,59,72,74-76,78,80-86,89,90,92,94,98,100,101,110,111,114,115,119-125,128,130-132,136,138,139,141,143,148-150,154] These included 46 RCTs,[56,58,59,72,74-76,78,80-86,89,90,92,94,98,101,110,111,114,115,119,121-125,128,130-132,136,138,139,141,143,148-150,154] of which 11 met criteria for good quality[56,58,74,76,86,92,121,125,139,141,150] and 33 were fair quality[59,72,75,78,80-85,89,90,94,98,101,110,111,114,115,119,122-124,128,130-132,136,138,143,148-150,154] (**Appendix C Table 1**). The remaining two trials were fair-quality CCTs (**Appendix C Table 2**).[100,120] One trial enrolled women with normal BMI at baseline,[92] 24 trials enrolled women in mixed BMI categories,[72,74-76,78,80-82,84,89,100,101,110,111,115,122,124,128,131,132,138,139,143,148] 10 were trials of women in the obese category only,[58,59,83,90,114,120,121,136,150,154] and 13 were trials of women in overweight or obese categories.[56,85,86,94,97,119,123,125,130,141,149] There were 32 trials of counseling-only interventions and 16 trials of active interventions, 7 of which also included counseling plus an active component. The intensity of interventions was low in 8 trials,[75,76,84,89,119,126,131,132] moderate in 16 studies,[56,72,74,83,85,92,100,114,115,120,122,123,128,136,143,154] and high in 24 trials.[58,59,78,80-82,86,90,94,97,101,110,111,121,124,125,138,139,141,148-150] Thirty-one trials reported on the outcome of cesarean delivery,[56,58,72,74,78,80-82,85,86,89,92,94,97,110,111,114,122-125,128,130-132,136,138,141,149,150,154] not specified as emergency or elective (N=14,521), while 10 trials[59,83,84,90,101,115,119,139,143,148] specified outcomes as elective cesarean (N=5,222) and 13 trials[59,76,83,84,90,92,101,115,119,121,139,143,148] reported separate rates of emergency cesarean (N=7,085); one trial[149] reported indications for emergency cesarean.

GWG interventions were not associated with decreased likelihood of cesarean delivery versus controls (34 trials; RR, 0.98 [95% CI, 0.91 to 1.04]; I^2=10.8%; ARD, -0.7% [95% CI, -2.4 to 0.8]) (**Table 4, Figure 4**). However, when pooled separately, GWG interventions were associated with a reduced risk of emergency cesarean (13 trials; RR, 0.87 [95% CI, 0.75 to 0.98]; I^2=0%; ARD, -2.2% [95% CI, -4.0 to 0.0]). Indications for emergency cesarean were rarely reported. Based on stratified analysis, there was no statistically significant interactions between effects of GWG interventions on likelihood of cesarean delivery and BMI category (p=0.70 for interaction), intervention type (p=0.37 for interaction), or intensity (p=0.37 for interaction; **Table 4**).

Preeclampsia

Twenty-eight trials (N=17,002) reported effects of GWG interventions on rates of preeclampsia (**Appendix B Tables 1-3**).[56,58,59,72,76,80,83,89,92,101,114,115,117,119,120,122,123,128,130,131,136,137,139,141,148,150,154] Of 27 included RCTs, 8 were rated good quality[56,58,76,92,117,139,141,150] and 19 were rated fair quality[59,80,83,89,114,119,122,123,128,130,131,148,154] (**Appendix C Table 1**). The remaining trial was a fair-quality CCT (**Appendix C Table 2**).[120] Most studies defined preeclampsia as gestational hypertension accompanied by proteinuria (greater than 300 mg/24 hours). The remaining trials reported preeclampsia as a clinically distinct event from gestational hypertension but did not provide a formal definition.

There was one trial of women in normal BMI category,[92] 12 trials of women with mixed prepregnancy BMI categories,[72,76,80,89,101,115,117,122,128,131,139,148] 6 trials of women in overweight or obese category,[56,119,123,130,141] and 9 trials of women categorized as obese only.[58,59,83,114,120,136,137,150,154] Some trials included multiple discrete populations. Six trials assessed active exercise interventions,[59,80,101,130,139,141] while the remaining 22 trials evaluated counseling-only interventions.[56,58,72,76,83,89,92,114,115,117,119,120,122,123,128,131,136,137,148,150,154] Intensity of the intervention was rated low in 5 trials,[76,84,89,119,131] moderate in 14 studies,[56,72,83,92,114,115,117,120,122,123,128,136,137,154] and high in 9 trials.[58,59,80,101,130,139,141,148,150]

Interventions for GWG were not associated with a risk of preeclampsia versus controls (27 trials; RR, 0.98 [95% CI, 0.84 to 1.13]; I^2=0%; ARD, 0.1% [95% CI, -0.6 to 0.5]; **Table 5, Figure 5**). Based on stratified analysis, there were no statistically significant interactions between effects of GWG interventions on risk of preeclampsia and BMI category (p=0.86 for interaction), intervention type (p=0.25 for interaction), or intensity (p=0.29 for interaction; **Table 5**).

Postpartum Hemorrhage

Ten trials (N=6,488) reported the association between GWG interventions and risk of postpartum hemorrhage during or immediately following delivery (**Appendix B Tables 1-3**).[56,72,84,92,101,119,120,123,140,141] Studies included four RCTs rated good quality, while five RCTs and one CCT were fair quality (**Appendix C Tables 1-2**). There was one trial of women with normal BMI, four trials of women with mixed prepregnancy BMI categories, four trials of women in the overweight or obese BMI category, and one trial of women in the obesity only category.[120] Three trials[101,139,141] assessed active exercise interventions, while the remaining seven trials evaluated counseling-only interventions. Interventions were of low (2 trials),[84,119] moderate (5 trials),[56,72,92,120,123] or high intensity (3 trials).[101,139,141] Hemorrhage was defined as greater than 500 milliliters (mL)[140] in one trial, 600 mL[56,92] in or 1,000 mL[119,141] in two trials each, and was not formally defined in five trials.[72,84,101,120,123] Pooled results of nine trials demonstrated no effect of interventions on likelihood of postpartum hemorrhage (RR, 1.00 [95% CI, 0.88 to 1.15]; I^2=0%; ARD, -0.1% [95% CI, -1.3 to 1.5]) (**Table 6, Figure 6**). Based on stratified analysis, there were no statistically significant interactions between effects of GWG interventions on likelihood of postpartum hemorrhage and BMI category (p=0.65 for interaction), intervention type (p=1.00 for interaction), or intensity (p=0.99 for interaction; **Table 6**).

Perineal Trauma

Eight RCTs (N=5,781) reported the association between GWG interventions and risk of perineal trauma during delivery (**Appendix B Tables 1-3**).[56,76,84,92,98,119,140,141] Five trials were good quality[56,76,92,139,141] and three trials were fair quality (**Appendix C Tables 1-2**).[84,97,119] There was one trial of women with normal BMI,[92] three trials of women with mixed categories of prepregnancy BMI, and four trials of women with prepregnancy BMI categories of overweight or obese. Three trials[97,139,141] assessed active exercise interventions, while the other five trials[56,76,84,92,119] evaluated counseling-only interventions. The intensity of interventions was low in three trials,[76,84,119] moderate in two trials,[56,92] and high in three trials.[97,139,141] Perineal trauma was defined as third- or fourth-degree perineal tear in five trials[56,84,98,119,140] and tear of any degree in two trials[76,141]; one trial reported both definitions.[92] Pooled analysis from eight trials showed no effect of interventions on risk of perineal trauma (RR, 0.86 [95% CI, 0.52 to 1.50]; I^2=57.0%; ARD, -0.7% [95% CI, -3.2 to 1.7]) (**Table 7, Figure 7**). Based on stratified analysis, there was a statistically significant interaction between effects of GWG intervention on risk of perineal trauma and mixed BMI category (p=0.003 for interaction) and low or high intervention intensity (p=0.003 for interaction), but not intervention type (p=0.73 for interaction; **Table 7**).

Maternal Mortality

One good-quality, moderate-intensity and one fair-quality, low-intensity counseling-only RCT (reported in three publications; N=2,994) reported rates of maternal death (**Appendix B Tables 1-3**).[56,84,91] Three maternal deaths total were reported in two trials, with two in the control group and one in the intervention group. None of the deaths reported were related to the interventions.

Effects of Interventions to Reduce Prepregnancy Weight on Weight and Health Outcomes in Women Who Are Overweight or Obese and Their Infants

One trial evaluated a prepregnancy intervention.[116] One trial, aimed at preventing GDM in high risk pregnant women, included a prepregnancy arm.[137]

A good quality counseling RCT (N=326) evaluated the effect of intentional weight loss for women with overweight or obese BMI before pregnancy on gestational weight gain and other pregnancy outcomes.[116] The high intensity behavioral weight loss intervention consisted of weekly health-coaching phone sessions that included information on weight loss, healthy diet, and exercise aimed at women planning pregnancy within two years. Phone coaching continued monthly throughout pregnancy. There was a significant difference in prepregnancy weight loss for the intervention participants versus controls (mean kg per week [SD]: -0.25 (0.51) vs. -0.03 (0.21), p<0.001). However, intervention participants gained more weight than controls during pregnancy (mean kg [SD]: 13.2 (8.2) vs. 10.3 (7.41); p=0.03), with no difference in rates of exceeding GWG guidelines at any time point.

A fair quality counseling RCT (N=128) had an arm that enrolled high-risk women with obesity or with a history of GDM planning a pregnancy.[137] Women planning pregnancy received lifestyle counseling every 3 months and those with BMI ≥ 25 were also encouraged to lose 5-10% of their weight before pregnancy. The number of women who were given weight loss advice and the weight change in the groups prior to pregnancy were not reported. GDM was defined as one or more pathological glucose values in a 75 g 2-hour oral glucose tolerance test, performed between 12 and 16 weeks of gestation, inconsistent with current definitions of GDM. For those testing negative, the test was repeated between 24-28 weeks gestation. The incidence of GDM as traditionally defined (24-28 weeks) was high in both the intervention and the control groups (21.5% vs 23.8%, respectively), but the difference was not statistically significant.

Effects of Interventions to Limit Excess Gestational Weight Gain on Infant Health Outcomes

Summary

- GWG interventions were associated with decreased risk of infant macrosomia (25 trials; RR, 0.77 [95% CI, 0.65 to 0.92]; I^2=38.3%; ARD, -1.9% [95% CI, -3.3 to -0.7]) and large for gestational age (26 trials; RR, 0.89 [95% CI, 0.80 to 0.99]; I^2=0%; ARD, -1.3% [95% CI, -2.3 to -0.3]) versus controls.
- GWG interventions were not associated with risk of preterm birth (33 trials; RR, 0.93 [95% CI, 0.81 to 1.07]; I^2=2.2%; ARD, -0.2% [95% CI, -1.1 to 0.7]); respiratory distress syndrome (8 trials; RR, 1.00 [95% CI, 0.67 to 1.42]; I^2=0%; ARD, -0.3% [95% CI, -1.3 to 0.7]), shoulder dystocia (8 trials; RR, 1.05 [95% CI, 0.63 to 1.47]; I^2=0%; ARD, 0.0% [95% CI, -0.4 to 0.5]), or NICU admissions (14 trials; RR, 0.98 [95% CI, 0.86 to 1.08]; I^2=0%; ARD, -0.7% [95% CI, -1.9 to 0.5]).
- GWG interventions were not associated with effects on infant growth during first year of life, or with neonatal death/stillbirth.

Evidence

Macrosomia

Twenty-six trials and one CCT (N=14,213) evaluated effects of GWG interventions on risk of macrosomia; 9 were good quality[56,58,74,76,92,117,139,141,150] and 18 fair quality[59,77,79,80,82,85,90,98,100,114,115,122,124,128,130,131,138,148] (**Appendix B Tables 1-3 and Appendix C Tables 1-2**). Macrosomia was defined as term infants weighing more than 4 kg (21 RCTs,[58,59,74,77,79,80,82,85,92,117,122,124,128,130,131,138,139,141,148,150,163] 1 CCT[100]) or 4.5 kg (6 RCTs),[76,90,92,114,115,117] with two trials[92,117] reporting outcomes for both definitions. There was one trial with women with normal BMI,[92] 16 trials with women with mixed BMI categories,[74,76,77,79,80,82,100,115,117,122,124,128,131,138,139,148] 5 of women with prepregnancy BMI categories of overweight or obese,[56,85,98,130,141] and 5 of women with BMI category of obesity only.[58,59,90,114,150] Twelve interventions were active[59,77,79,80,82,90,124,130,138,139,141] and 14 were

counseling-only; intensity was rated low in 2 trials,[76,131] moderate in 10,[74,85,91,92,100,114,115,117,122,128] and high in 15 trials.[58,59,77,79,80,82,90,124,130,138,139,141,148,150]

GWG interventions were associated with decreased risk of macrosomia versus controls (25 trials; RR, 0.77 [95% CI, 0.65 to 0.92]; I^2=38.3%; ARD, -1.9% [95% CI, -3.3 to -0.7]) (**Table 8, Figure 8**). When stratified by definition, GWG interventions were associated with decreased risk of macrosomia in trials using the definition of greater than 4 kg (21 trials; RR, 0.75 [95% CI, 0.62 to 0.89]; I^2=39.0%), but not using the definition of greater than 4.5 kg (4 trials; RR, 1.47 [95% CI, 0.53 to 3.14]; I^2=0%). Stratified analysis demonstrated interactions between effects of GWG interventions on risk of macrosomia and higher intervention intensity (p=0.03 for interaction), but not BMI category (p=0.24 for interaction) or intervention type (p=1.00 for interaction; **Table 8**).

Large for Gestational Age (LGA)

Twenty-seven RCTs (N=13,070) reported the outcome of LGA infants, defined as birthweight greater than the 90th percentile for gestational age. Eleven were rated good quality[56,58,76,86,92,117,121,139,141,142,150] and 16 were fair-quality trials (**Appendix B Tables 1-3 and Appendix C Tables 1-2**).[59,72,84,85,90,94,101,108,110,111,115,123,132,136,148,149] There was one trial with women with normal BMI,[92] 11 trials with women with mixed BMI categories,[72,76,84,101,110,111,115,117,132,139,148] 8 of women with prepregnancy BMI categories of overweight or obese,[56,85,86,94,108,117,123,141,149] and 7 of women with prepregnancy BMI category of obese.[58,59,90,121,136,142,150] Seven trials were active,[59,90,101,110,111,139,141] and the remainder were counseling-only interventions. Intervention intensity was rated low in 3 trials,[76,84,132] moderate in 9,[56,72,85,92,115,117,123,136,142] and high in 15 trials.[58,59,86,90,94,101,107,110,111,121,139,148-150]

Pooled estimates demonstrated a statistically significant effect of GWG interventions on LGA (26 trials; RR, 0.89 [95% CI, 0.80 to 0.99]; I^2=0%; ARD, -1.3% [95% CI, -2.3 to -0.3]) (**Table 9, Figure 9**). Stratified analysis demonstrated no interactions between effects of GWG interventions on risk of LGA and BMI category (p=0.98 for interaction), intervention type (p=0.18 for interaction), or intensity (p=0.22 for interaction; **Table 9**).

Preterm Birth

Thirty-four RCTs and one CCT[120] (N=17,166) reported on the outcome of preterm birth. Ten were rated good quality[56,58,74,76,86,92,121,139,141,150] and 25 were fair quality (**Appendix B Tables 1-3 and Appendix C Tables 1-2**). There was 1 trial with women with normal BMI,[92] 19 studies with women with mixed BMI categories,[72,74,76,77,79-82,89,101,115,120,122,128,132,138,139,143,148] 9 trials in women with prepregnancy BMI categories of overweight or obese,[56,85,86,94,126,130,141,149] and 6 in women with prepregnancy BMI category of obese.[58,90,120,121,136,150] Thirteen were active,[77,79-82,90,101,130,138,139,141] and 22 were counseling-only interventions. Intervention intensity was rated low in 5 trials,[76,89,126,131,132] moderate in 10 studies,[56,72,74,85,92,115,120,122,128,136,143] and high in 20 trials.[58,77,79-82,86,90,94,101,121,130,138,139,141,148-150] Preterm birth was defined as delivery at less than 37 weeks in 25 studies,[56,58,72,74,76,77,79-82,86,89,90,92,94,115,120-122,136,140,141,148-150] less than 36 weeks in 5 trials,[72,128,130,131,138] and 5 trials did not report a definition.[85,101,126,132,143] GWG interventions were

not associated with a lower risk of preterm birth (33 trials; RR, 0.93 [95% CI, 0.81 to 1.07]; I^2=2.2%; ARD, -0.2% [95% CI, -1.1 to 0.7]) (**Table 10, Figure 10**).

When stratified by definition, GWG interventions were not associated with risk of preterm birth before 37 weeks' gestation (24 trials; RR, 0.94 [95% CI, 0.81 to 1.10]; I^2=3.5%), birth before 36 weeks' gestation (4 trials; RR, 1.04 [95% CI, 0.61 to 2.08]; I^2=0%) or undefined preterm birth (5 trials; RR, 0.50 [95% CI, 0.10 to 1.33]; I^2=7.1%). There were no statistically significant interactions between effects of GWG interventions on risk of preterm birth and BMI category (p=0.10 for interaction), intervention type (p=0.56 for interaction), or intensity (p=0.42 for interaction; **Table 10**).

Respiratory Distress Syndrome

Eight counseling-only RCTs (N=3,155; 4 good and 4 fair quality) of women with mixed (2 trials), overweight or obese (2 trials), or obese only (4 trials) prepregnancy BMI categories evaluated effects of GWG interventions on risk of respiratory distress syndrome (**Appendix B Tables 1-3 and Appendix C Tables 1-2**).[76,84,86,114,136,137,141,150] Intervention intensity was low in two trials, moderate in three trials, and high in three trials. Pooled estimates demonstrated no effect of GWG interventions on risk of respiratory distress syndrome (8 trials; RR, 1.00 [95% CI, 0.67 to 1.42]; I^2=0%; ARD, -0.3% [95% CI, -1.3 to 0.7]) (**Table 11, Figure 11**). There were no statistically significant interactions between effects of GWG interventions on risk of respiratory distress syndrome and BMI category (p=0.19 for interaction), intervention type (p=0.25 for interaction), or intensity (p=0.42 for interaction; **Table 11**).

Shoulder Dystocia

Eight counseling RCTs (N=6,461; 4 good quality and 4 fair quality) found no difference in rates of shoulder dystocia for normal (1 trial), mixed (4 studies), or overweight or obese (3 studies) prepregnancy BMI categories for one active and seven counseling-only interventions compared to controls (**Appendix B Tables 1-3 and Appendix C Tables 1-2**).[56,76,84,89,92,119,123,139] Intervention intensity was low in four trials, moderate in three trials, and high in one trial. There was no effect of GWG interventions on rates of shoulder dystocia based on pooled estimates (8 trials; RR, 1.05 [95% CI, 0.63 to 1.47]; I^2=0%; ARD, 0.0% [95% CI, -0.4 to 0.5]; **Table 12, Figure 12**). There were no statistically significant interactions between effects of GWG interventions on risk of shoulder dystocia and BMI category (p=0.55 for interaction), intervention type (p=0.61 for interaction), or intensity (p=0.89 for interaction; **Table 12**).

NICU Admission

Fifteen RCTs (N=8,523) of women (8 of good quality, 7 fair quality) with normal (1 trial), mixed (6 trials), overweight or obese (4 trials), or obese (4 trials) prepregnancy BMI categories reported on rates of NICU or special care nursery admission, with no reported differences in rates between intervention and control groups in five active or 10 counseling-only intervention trials (**Appendix B Tables 1-3 and Appendix C Tables 1-2**).[56,59,72,76,84,86,89,90,92,101,121,123,139,141,150] Intensity was rated low in three trials, moderate in four, and high in eight trials. Pooled estimates

demonstrated no effect of GWG interventions on rates of NICU admission (14 trials; RR, 0.98 [95% CI, 0.86 to 1.08]; I^2=0%; ARD, -0.7% [95% CI, -1.9 to 0.5]; **Table 13, Figure 13**). There were no statistically significant interactions between effects of GWG interventions on risk of NICU admission and BMI category (p=0.38 for interaction), intervention type (p=0.47 for interaction), or intensity (p=0.82 for interaction; **Table 13**).

Neonatal Death

Eleven RCTs (N=7,090) of women with normal (1 trial), mixed (4 trials), overweight or obese (4 trials), or obese (2 trials) prepregnancy BMI categories reported rates of neonatal death or stillbirth, with no significant differences reported between intervention versus control groups (**Appendix B Tables 1-3**).[56,59,72,84-86,89,92,121,139,141] In the six good-quality[56,86,121,139,141] and five fair-quality trials,[59,72,84,85] three interventions were considered active and eight were counseling-only, and intervention intensity was rated low in two studies, moderate in four, and high in five studies. Data were not pooled for this outcome given heterogeneity in outcome categorization and low event rates.

Growth During the First Year of Life

Three counseling-only RCTs (N=2,516) of low, moderate, or high intensity found no differences between interventions during pregnancy versus usual care on infant growth during the first year of life (**Appendix B Tables 1-3**).[91,133,147] One good-quality RCT[91] of women with overweight or obese prepregnancy BMI categories reported the incidence of infant BMI z-score greater than or equal to both 85 percent and 90 percent at 6 months of age, and found no differences between groups. Two fair-quality RCTs of women with mixed BMI categories reported infant weight at 12 months postpartum following a counseling-only intervention during pregnancy and reported no difference between intervention and controls.[133,147]

Effects of Interventions to Limit Excess Gestational Weight Gain on Gestational Weight Outcomes

Summary

- Interventions were associated with decreased mean GWG versus controls (55 trials; MD, -1.02 kg [95% CI, -1.30 to -0.75]; I^2=60.3%). Statistically significant interactions were present between effects of GWG intervention on mean GWG and high intensity interventions (p<0.001 for interaction), but not for BMI category (p=0.06 for interaction), intervention type (p=0.07 for interaction), study quality (p=0.30 for interaction), or weight assessment timepoint (p=0.26 for interaction).
- Interventions were associated with decreased likelihood of exceeding IOM recommendations for GWG (39 trials; RR, 0.84 [95% CI, 0.78 to 0.90]; I^2=63.2%; ARD, -7.7% [95% CI, -11.0 to -4.6]); stratified analysis demonstrated statistically significant interactions between effects of GWG interventions on likelihood of GWG and active

interventions (p<0.001 for interaction) and high intensity interventions (p<0.001 for interaction), but not BMI category (p=0.50 for interaction).

- GWG interventions were not associated with improved adherence to IOM recommendations for GWG, defined by neither gaining excessive weight nor failing to gain sufficient weight (19 trials; RR, 1.10 [95% CI, 0.89 to 1.35]; I^2=84.3%; ARD, 4.2% [95% CI, -1.2 to 10.0]). There were no interactions between effects of GWG interventions on adherence to GWG recommendations and BMI category (p=0.09 for interaction), intervention type (p=1.00 for interaction), or intensity (p=1.00 for interaction).
- GWG interventions were associated with decreased postpartum weight retention (PPWR) at the followup time point of 12 months (10 trials; MD, -0.63 kg [95% CI, -1.44 to -0.01]; I^2=65.5%), but not less than 6 months (6 trials; MD, -0.81 kg [95% CI, -2.40 to 0.55]; I^2=84.4%) or 6 months (3 trials; MD, -0.85 kg [95% CI, -3.67 to 0.81]; I^2=70.6%). There were no interactions between effects of GWG interventions on PPWR and BMI category at up to 6 months (p=0.41) or 12 months (p=0.75) postpartum; however, the number of trials was small and estimates were imprecise.

Evidence

All 67 included trials (reported in 86 publications) conducted during pregnancy evaluated effects of GWG interventions on mean GWG (**Appendix B Tables 1-3**).[56,58,59,71-115,117-154] Fifteen studies were rated good quality[56,58,74,76,86,91-93,96,104,105,113,117,121,125,139,141,142,150,151] and 52 were rated fair quality.[59,71-73,75,77-85,87-90,94,97,99-103,106-112,114,115,118-120,122-124,126-138,143-149,152-154] Sample sizes ranged from 50 to 2,261 (N=25,463, median=230), and reported sample mean ages ranged from 18.6 years to 33.8 years. One trial reported outcomes in women with normal prepregnancy BMI category,[92] 34 studies[71,72,74-82,84,89,99-102,109-111,115,118,122,124,127,128,131-133,135,138,139,143,144,147,148] reported outcomes in women with mixed prepregnancy BMI categories (including one[88] with women whose prepregnancy BMI was normal or overweight only); 19 with women with overweight or obese categories[56,73,85,86,91,93,94,96-98,103-108,113,117,119,123,125,126,129,130,134,141,149,153]; and 13 with women with prepregnancy BMI category of obesity only.[58,59,83,87,90,114,120,121,136,137,142,145,146,150-152,154]

Mean Gestational Weight Gain

GWG interventions were associated with reduced gestational weight gain during pregnancy of approximately one kilogram versus controls (55 trials; N=20,090; MD, -1.02 kg [95% CI, -1.30 to -0.75]; I^2=60.3%) (**Table 14, Figure 14**). Fourteen trials were rated good quality, and 41 were fair quality (**Appendix C Table 1**). High-intensity interventions were associated with greater effects (28 trials; MD, -1.47 kg [95% CI, -1.78 to -1.22]; I^2=13.0%) than moderate (18 trials; MD, -0.32 kg [95% CI, -0.71 to -0.04]; I^2=17.6%) or low-intensity interventions (9 trials; MD, -0.64 kg [94% CI, -1.44 to 0.02]; I^2=48.4%; p<0.001 for intensity subgroup interaction) (**Table 14, Appendix D Figure 1)**.

There was no association between effects of GWG interventions and prepregnancy BMI category (p=0.06 for BMI category interaction). Subgroup analyses demonstrated a greater effect of GWG

interventions for women in the obesity category (18 trials; MD, -1.63 [95% CI, -2.45 to -0.91]; I^2=63.0%) than in the overweight category (10 trials; MD, -0.89 [95% CI, -1.54 to -0.32]; I^2=15.5%), overweight and obesity weight categories combined (20 trials; MD, -0.90 [95% CI, -1.38 to -0.46]; I^2=31.1%), mixed weight categories (28 trials; MD, -0.81 [95% CI, -1.16 to -0.46]; I^2=60.7%); or normal weight category (8 trials; MD, -0.48 [95% CI, -96 to -0.21]; I^2=0.0%; **Table 14, Appendix D Figure 2**).

Additional subgroup analyses did not show any statistically significant interactions between effects of GWG interventions on weight gain and the intervention type (counseling-only vs. active; p=0.07), study quality (p=0.30), or timing of assessment of weight gain (p=0.26) (**Table 14, Appendix D Figures 3-5**).

Subgroup analyses based on demographic characteristics or socioeconomic status could not be conducted due to sparse data (**Appendix B Table 3**). Two trials enrolled low-income African American women exclusively,[86,108] two enrolled low-income Latina women (one study exclusively of Latina women),[99,106] and one enrolled low-income White (61%) and Black (39%) women.[131] Results in these trials generally were consistent with overall findings, although the estimates of mean GWG in the two studies of African American women were slightly higher (MDs of -1.59 and -3.10 kg) than the studies of Latina women, which reported more inconsistent effects (MDs of -0.14 and -1.32 kg). One trial found no interaction between BMI category, income level, and effects of GWG interventions on mean GWG (p=0.16).[122]

Exceeding IOM Recommendations for Gestational Weight Gain

Forty-one RCTs and one CCT (N=14,895) reported GWG in excess of the IOM recommendations as a dichotomous outcome (**Appendix B Tables 1-3**).[59,73-75,77,79-82,84,86,88-90,92,94,97,99,108,110,111,113,115,118-120,122,124,125,128,130-132,134,135,138,142-144,149,150,153] Seven trials were rated good quality, and 35 trials fair quality (**Appendix C Tables 1-2**); 15 were active interventions[59,77,79-82,90,97,99,110,111,124,125,130,138] and the remainder were counseling-only (**Appendix B Table 1**). GWG interventions were associated with decreased likelihood of gaining weight in excess of IOM recommendations (39 trials; RR, 0.84 [95% CI, 0.78 to 0.90]; I^2=63.2%; ARD, -7.7% [95% CI, -11.0 to -4.6]) (**Table 15, Figure 15**).

Stratified analysis demonstrated statistically significant interactions between effects of GWG interventions on likelihood of exceeding GWG recommendations and active interventions (p<0.001 for interaction) and high intensity interventions (p<0.001 for interaction), but not BMI category (p=0.50) (**Table 15**).

Adherence to IOM Recommendations for Gestational Weight Gain

Nineteen trials[59,75,81,84,99,119,123,125,126,128,131,135,138,142,143,148,150] (N=5,839) reported on the outcome of rates of adherence to GWG guidelines according to ranges recommended by the IOM (i.e., neither gaining excessive weight nor failing to gain sufficient weight) by prepregnancy BMI category (**Appendix B Tables 1-3**).[59,75,81,84,89,92,99,119,123,125,126,128,131,135,138,142,143,148,150] Four trials were rated good quality and 15 fair quality (**Appendix C Table 1**). There were five active

trials,[59,81,99,125,138] and the remainder included counseling-only interventions (**Appendix B Table 1**). There was no difference between GWG interventions and controls in likelihood of adherence to IOM recommendations for GWG (19 trials; RR, 1.10 [95% CI, 0.89 to 1.35]; I^2=84.3%; ARD, 4.2% [95% CI, -1.2 to 10.0]), although statistical heterogeneity was substantial (**Table 16, Figure 16**).

There was no statistically significant interaction between effects of GWG interventions on adherence to IOM recommendations for GWG and BMI category (p=0.09 for interaction), intervention type (p=1.00 for interaction), or intensity (p=1.00 for interaction) (**Table 16**).

Postpartum Weight Retention

Fourteen trials in 26 publications (N=5,060) evaluated the effects of GWG interventions on postpartum weight retention (**Appendix B Tables 1-3**).[59,74,96,100,102-105,107-109,112,114,115,127-129,131-133,139,140,150-152,154] There were 13 RCTs (4 rated good quality[74,104,105,139,140,150,151] and 9 rated fair quality)[59,102,107-109,112,114,127,128,131-133,152,154] and one fair-quality CCT[100] (**Appendix C Tables 1-2**). Two trials enrolled women with prepregnancy BMI categories of overweight or obese,[105,107] four enrolled women categorized as obese only,[112,151,152,154] and eight trials enrolled women with mixed BMI categories.[74,100,102,109,127,128,131-133,140] Three trials[59,102,139] evaluated active exercise interventions, while 11 assessed counseling-only interventions. Intensity was rated as low in two studies,[131-133] moderate in seven,[74,100,105,109,112,128,154] and high in five studies.[102,107,139,151,152] Weight gain was reported from less than 6 months to 12 months postpartum.

GWG interventions were associated with statistically significant effects on postpartum weight retention at 12 months (10 trials; MD, -0.63 kg [95% CI, -1.44 to -0.01]; I^2=65.5%),[74,103,107,109,112,127,129,133,140,151] but not at less than 6 months (9 trials; MD, -0.81 kg [95% CI, -2.40 to 0.55]; I^2=84.4%)[96,105,109,110,112,131,132,154] or 6 months postpartum (3 trials; MD, -0.85 kg [95% CI, -3.67 to 0.81]; I^2=70.6%)[107,128,152] (**Table 17, Figure 17**). There were no statistically significant interactions between effects of GWG interventions on postpartum weight retention and BMI category at followup time of up to 6 months (p=0.41) or 12 months (p=0.75) (**Table 17**; **Appendix D Figures 6-8**).

Harms of Interventions to Limit Excess Gestational Weight Gain Among Pregnant Women and Their Infants

Summary

- Evidence was mixed on the effect of GWG interventions on maternal anxiety and depression based on various validated symptom scales in twelve studies.
- Interventions were not associated with SGA infants based on pooled analysis (20 trials; RR, 0.94 [95% CI, 0.80 to 1.10]; I^2=0.0%; ARD, -0.4% [95% CI, -1.7 to 1.0]). There was a statistically significant interaction between effects of GWG interventions on risk of SGA and intervention intensity (p=0.04 for interaction), but not BMI category (p=0.91 for interaction) or intervention type (p=0.77 for interaction).

Evidence

Evidence on harms associated with GWG interventions was very limited, with most studies not reporting harms related to the intervention (**Appendix B Table 3**). Limited data were available on effects of GWG interventions on psychological symptoms related to GWG interventions and risk of SGA infants. No study reported effects of GWG interventions on the outcomes of stigma, maternal musculoskeletal injuries, or other harms.

Depression and Anxiety

Twelve studies (N=3,116) of GWG interventions reported effects on maternal depression and anxiety (**Appendix B Tables 1-3**).[71,83,87-89,92,93,95,101,121,125,143] Ten were randomized trials (three good quality and seven fair quality), and two were controlled prospective cohort studies (one good quality, one fair quality)[87,93] (**Appendix C Tables 1- 2**). Different validated scales were used to measure anxiety and depression symptoms in these studies; therefore, pooling was not possible. Eight trials evaluated symptoms with the Edinburgh Postnatal Depression Scale (EPDS) scale at various time points or postpartum,[71,83,87,92,95,101,121,143] but three trials did not report scores;[83,87,121] two trials reported scores based on the Hospital Anxiety Depression Scale (HADS);[88,89] and a number of trials used different validated scales for measuring anxiety or depression.[83,87,92,93,95,101,121,125]One trial enrolled women with normal BMI category,[92] five trials enrolled women in mixed BMI categories,[71,88,89,101,143] three studies enrolled women in prepregnancy categories of overweight and obese,[93,95,125] and three studies enrolled women in the obese only prepregnancy BMI category.[83,87,121] There were five active[71,87,95,101,125] and seven counseling-only[83,88,89,92,93,121,143] interventions. Intervention intensity was low in two trials,[88,89] moderate in three trials,[83,92,143] and high in seven trials.[71,87,93,95,101,121,125]

Effects of GWG interventions on maternal depression and anxiety were mixed. A fair quality trial (N=140)[71] evaluating a high intensity, active intervention found that scores on the Edinburgh Postnatal Depression Scale (EPDS) were lower in women in a water exercise group than in controls (EPDS score, mean (SD): 6.41 (3.7) vs. 10.2 (2.4), $p<0.001$). An additional fair quality trial (N=172)[101] evaluating a high intensity, active exercise intervention did not report differences between groups in EPDS scores over time, but reported a significant difference in psychological distress using the 21-item Depression Anxiety Stress Scale (DASS-21), used to evaluate general psychological distress (DASS-21 score, median (IQR): 6 (2-10) vs. 7 (4-11), $p<0.05$). A good quality, high intensity counseling intervention (N=230)[121] found that dietary education was not associated with differences in anxiety or depression based on the State and Trait Anxiety Inventory (STAI) or EPDS. Another good quality trial (N=215)[93] evaluating a high intensity counseling intervention used standardized measures used to assess intervention effects on changes in psychological outcomes. There were significant decreases in depressive symptoms from baseline to the post-intervention period in the intervention group versus controls (4.5 (3.7) vs. 6.1 (4.5); -1.95, 95% CI, -3.35 to -0.55, $p=0.007$), but no difference between groups in pregnancy-related anxiety using the pregnancy-related anxiety scale. A fair quality trial (N=261)[143] evaluating a moderate intensity counseling intervention demonstrated no difference in psychological variables between intervention and control groups as measured by the EPDS and the DASS-21 at 15 weeks and 33 weeks gestation. A good quality counseling trial (N=633)

in women with normal weight used three different scales to measure maternal quality of life and emotional well-being.[92] There were no differences between intervention and control groups for the EPDS, SF-12, or STAI scores at any of the three measured time points (trial entry, 28, and 36 weeks).

A fair quality active trial (N=91), designed as a secondary analysis to evaluate the outcome of psychological well-being among women with overweight and obese BMI, used the Psychological General Well-Being Index to measure outcomes during pregnancy and the EPDS for assessing postpartum depression.[95] There were no differences in either set of scores between intervention and control groups, demonstrating no effect of a supervised exercise program during pregnancy on psychological well-being. One good quality RCT (N=106)[125] found an active GWG intervention associated with decreased likelihood of third trimester depression based on Center for Epidemiological Studies Depression Scale score (with depression indicated by scores greater than or equal to 16). Scores in the intervention group were significantly lower in the third trimester compared to the first trimester for the entire group (χ^2=16.36, p=0.00) and in all BMI categories. One fair quality trial (N=205)[83] found a high intensity counseling intervention was associated with small differences in anxiety symptom scores using the STAI, but no difference in depressed mood based on the EPDS. There was a statistically significant decrease in levels of anxiety in the intervention group and a statistically significant increase in anxiety among controls based on a multivariate model of state of anxiety by group (β-estimate [standard error], 1.04 [1.42] vs. 1.90 [1.52] vs. controls, p=0.02). One fair quality prospective intervention trial (N=348)[87] found no effects on depression or anxiety symptoms using the Beck Anxiety Inventory and the EPDS.[87] One fair quality RCT (N=78),[88] designed as a feasibility RCT to test the acceptability of a counseling intervention with community midwives, used the Hospital Anxiety and Depression Scale to evaluate symptoms of anxiety and depression. In this trial, and the follow up fair quality RCT (N=616) evaluating the same intervention, there were no significant differences in scores for anxiety or depression between intervention and control groups (anxiety, adjusted mean -0.58, 95% CI: -1.25 to -0.8; depression, adjusted mean -0.60, 95% CI: -1.24 to -0.05).[89]

Small for Gestational Age

Thirty studies (N=14,168) reported effects of GWG interventions on risk of infants small for gestational age (SGA); 29 were RCTs[58,72,76,77,80,84-86,90,92,94,100,101,108,115,117,121-123,128,130-132,138,139,141,142,148-150] and 1 was a CCT[87] (**Appendix B Tables 1-3**). SGA was defined as birthweight less than the 10th percentile for gestational age (20 studies),[58,72,76,85-87,90,92,94,101,115,117,121,123,132,139,141,142,148-150] low birth weight less than 2,500 g (12 studies),[77,80,90,92,100,122,128,130,131,138,141,148] or intrauterine growth restriction (1 study)[84]; three RCTs[92,141,148] reported both SGA and low birth weight. SGA, low birth weight, and intrauterine growth restriction were reported as secondary outcomes rather than as harms of GWG interventions. Ten RCTs trials met criteria for good quality,[58,76,86,92,117,121,139,141,142,150] and the remaining 20 studies (19 RCTs and 1 CCT) were rated fair quality (**Appendix Table C Tables 1-2**); eight were active interventions[77,80,90,101,130,138,139,141] and the remainder were counseling-only (**Appendix B Table 1**). One trial enrolled women with normal weight, 14 trials enrolled women with mixed weight categories, 10 with women with overweight or obesity, and 5 with

women with obesity; intensity was rated low in 4 trials, moderate in 10, and high in 16 (**Appendix B Table 1**).

In the 20 SGA trials (N=8,981), there was one trial in women with normal BMI,[92] eight trials in women with mixed BMI categories,[72,76,100,101,115,132,139,148] seven of women in the overweight or obese category,[85,86,94,117,123,141,149] and four of women in the obese category only.[58,121,142,150] Intensity was low in two trials,[76,132] moderate in seven trials,[72,85,92,115,117,123,142] and high in 11 trials[58,86,90,94,101,121,139,141,148-150]; four were active interventions[90,101,139,141] and the remainder were counseling-only.

GWG interventions were not associated with increased risk of SGA in 20 trials (RR, 0.94 [95% CI, 0.80 to 1.10]; I^2=0.0%; ARD, -0.4% [95% CI, -1.7 to 1.0]) (**Table 18, Figure 18**).[72,74,101,107,108,112,114,115,121,127,128,132,133,139-141,149,151] There was a statistically significant interaction between effects of GWG interventions on SGA and intervention intensity (p=0.04 for interaction), but not BMI category (p=0.91 for interaction) or intervention type (p=0.77 for interaction; **Table 18**).

Contextual Questions

Contextual Question 1. What Is the Association Between Gestational Weight Gain and Adverse Maternal and Infant Outcomes?

A 2008 systematic evidence review commissioned by AHRQ evaluated the association between GWG and infant and maternal outcomes.[23] Nearly all of the studies in the review were observational. Of 11 maternal and intrapartum outcomes reported, cesarean delivery was the only maternal outcome with evidence showing a moderate association with GWG; the association was stronger among women with overweight or obesity (OR, 1.3 [95% CI, 1.2 to 1.3]).[22] The review described the evidence on the association between GWG and other maternal outcomes (hypertensive disorders, abnormal glucose metabolism) as weak. For infant health outcomes (i.e., birth outcomes) there was moderate to strong evidence for an association between low GWG and preterm birth, low birth weight, and SGA, and strong evidence for the association between high GWG and high birthweight, macrosomia, and LGA. This systematic evidence review was used to inform the revised 2009 IOM GWG guidelines.

Systematic evidence reviews and meta-analyses of observational data conducted since the 2008 AHRQ review report similar findings.[23] GWG above 2009 guidelines was associated with higher risk of LGA, macrosomia, and cesarean section. Weight gain below guidelines was associated with higher risk of SGA and preterm birth. Most recently, the LifeCycle Project-Maternal Obesity and Childhood Outcomes Study Group conducted an individual participant-level meta-analysis using data from over 196,000 singleton pregnancies within 25 cohort studies from Europe and North America.[18] Excessive GWG in each prepregnancy weight category (including different obesity classes) was associated with adverse perinatal outcomes (e.g., the presence of one or more of the following outcomes: preeclampsia, gestational hypertension, gestational diabetes, cesarean delivery, preterm birth, SGA, or LGA). However, the predictive power of

GWG for the different adverse pregnancy outcomes was either low or moderate. In fact, the study group concluded that while optimal GWG may inform prenatal counseling, the optimal GWG ranges had limited predictive value for the adverse outcomes assessed.

Contextual Question 2. What Is the Association Between High Prepregnancy BMI and Risk of Adverse Maternal and Infant Outcomes?

A key result of the LifeCycle Project-Maternal Obesity and Childhood Outcomes Study was that prepregnancy BMI was more strongly associated with adverse maternal and infant outcomes than GWG.[18] Numerous observational studies have demonstrated an association between elevated BMI at pregnancy onset and adverse perinatal outcomes.[11,13,15,164-166] A 2017 umbrella review of 156 meta-analyses of cohort studies[8] evaluated the association between adiposity and multiple obstetric and gynecological outcomes; evidence was strongest for elevated prepregnancy BMI and increased risk of cesarean delivery (BMI less than 25 vs. greater than 30; OR, 2.00 [95% CI, 1.87 to 2.15]), preeclampsia (BMI less than 25 vs. 25-30; OR, 1.70 [95% CI, 1.60 to 1.81]), and antenatal depression (BMI less than 25 vs. greater than 30; OR, 1.48 [95% CI, 1.32 to 1.66]; $p<0.001$ for all comparisons). The evidence was highly suggestive for associations between elevated prepregnancy BMI and GDM, LGA, macrosomia, stillbirth, postpartum hemorrhage, and preterm birth. There was a dose-dependent association between increasing degree of maternal obesity and increased maternal morbidity.[17]

A large (N=226,958) population-based cohort study from Canada[167] examined the relationship between prepregnancy BMI and adverse pregnancy outcomes. The study estimated a 10 percent reduction in prepregnancy BMI would be associated with at least a 10 percent lower risk of preeclampsia, gestational diabetes, preterm delivery, macrosomia, and stillbirth. For example, women with a BMI of 36 kg/m^2 would have a 10 percent lower risk of these complications than women with a BMI of 40 kg/m^2. Larger declines in prepregnancy BMI (20% to 30%) were necessary to reduce risks of cesarean, shoulder dystocia, NICU stay 48 hours or longer, and in-hospital newborn mortality. Prepregnancy BMI was not associated with risk of postpartum hemorrhage requiring intervention, severe maternal morbidity or maternal mortality, or spontaneous preterm delivery before 32 weeks of gestation.

Contextual Question 3. Among Women With a High Prepregnancy BMI, What Is the Association Between Reduction in Prepregnancy Weight and Risk of Adverse Maternal and Infant Outcomes?

A 2018 systematic evidence review and meta-analysis found an interpregnancy BMI decrease (greater than 1 BMI unit) was associated with decreased risk of LGA (3 trials; adjusted odds ratio [aOR], 0.7 [95% CI, 0.6 to 0.9]), macrosomia (3 trials; aOR, 0.5 [95% CI, 0.4 to 0.7]), and GDM (3 trials; aOR, 0.3 [95% CI, 0.6 to 1.0]), but increased risk of SGA (3 trials; aOR, 1.3 [95% CI, 1.1 to 1.6]) and low birth weight (less than 2,500 g) (3 trials; aOR, 2.2 [95% CI, 1.4 to 3.5]).[168] One study that stratified women by BMI category found that those with normal BMI

who lost weight had a similar risk for SGA as those who were overweight/obese and lost weight.[169]

Increases in BMI between pregnancies among women with prepregnancy BMI greater than 25 kg/m^2 were associated with adverse pregnancy outcomes. A moderate increase in BMI was associated with increased risk of cesarean delivery and GDM; there was also an association with increased risk of LGA but this was not statistically significant.[168] A substantial increase in BMI (greater than 3 BMI units) was associated with significantly increased risk of LGA and GDM, and an increased risk of cesarean delivery that was not statistically significant.[168] However, the time between pregnancies was variable in these studies and could be quite long (years), which might not directly reflect the consequences of intentional weight loss prior to pregnancy.

A recent observational study of 16,395 women from the ELFE French national birth cohort examined the association between self-reported weight loss in the year prior to pregnancy and infant birthweight.[170] For women with normal or high BMI, GWG was higher for women with weight loss before pregnancy, compared with women with stable or moderate weight variation. For women with prepregnancy BMI <25 kg/m^2, infants of mothers with prepregnancy weight loss had higher mean birth weight compared to those from mothers with stable weight. For women with prepregnancy BMI >25 kg/m^2, weight loss before pregnancy was not associated with infant birth weight. Prepregnancy weight loss was not significantly associated with the risk of SGA and LGA for any group. In mediation analyses, the authors concluded that the increased GWG among those with prepregnancy weight loss seemed to negate an expected reduction of infant birth weight due to prepregnancy weight loss.[170]

Chapter 4. Discussion

Summary of Review Findings

This report synthesizes evidence on the effect of healthy weight and weight gain interventions during pregnancy on maternal and infant health outcomes, maternal weight outcomes, and harms. **Table 19** summarizes the evidence for this review; **Appendix E** summarizes the study characteristics of the included trials (**Appendix E Table 1**) and provides examples for potential implementation (**Appendix E Table 2**).

Evidence on effects of GWG interventions on maternal outcomes was most robust for gestational diabetes, gestational hypertension, preeclampsia, and cesarean delivery. Counseling-only and active GWG interventions were associated with decreased risk of GDM and emergency cesarean delivery. The absolute risk difference (ARD) for GDM was 1.6 percent; with a number needed to treat (NNT) to prevent one case of GDM of approximately 63. There were no statistically significant interactions between BMI categories, intervention type or intensity and effects on GDM. While the point estimate favored GWG interventions and was nearly statistically significant, there was no overall effect of GWG interventions on rates of gestational hypertension. Effects were observed in some stratified analyses for gestational hypertension, specifically decreased rates for high intensity interventions and active interventions, which may be related to a more direct relationship between these factors and effects on blood pressure. Interactions were also observed between effects of GWG interventions on perineal trauma and BMI category ($p=0.003$ for interaction) and intervention intensity ($p=0.003$ for interaction), but not for other maternal health outcomes. There was also no effect of GWG interventions on preeclampsia, a multisystem syndrome with less clear associations with BMI.[171] Importantly, studies included for this review that reported rates of hypertensive diseases of pregnancy distinguished between gestational hypertension and preeclampsia based on predefined diagnostic criteria.

Evidence on effects of GWG interventions on infant outcomes was most robust for macrosomia, LGA, and preterm birth. GWG interventions were associated with decreased risk of macrosomia and LGA, with ARD between 1 and 2 percent for both outcomes, resulting in a NNT of approximately 53 (95% CI, 31 to 250) to prevent one case of macrosomia and approximately 77 (95% CI, 42 to 333) to prevent one case of LGA. Evidence did not indicate effects of GWG interventions on risk of respiratory distress syndrome, shoulder dystocia, NICU admission, neonatal death, or stillbirth.

For weight-related outcomes, GWG interventions were associated with slightly less overall weight gain (MD, -1.02 kg) versus controls. The effects of interventions on GWG also tended to be greater in trials of high-intensity interventions (MD, -1.47 kg) compared with moderate- (MD, -0.32 kg) or low-intensity interventions (MD, -0.64 kg; $p<0.001$ for intensity subgroup interaction).

While the overall interaction between BMI and GWG was not statistically significant, the effects of GWG interventions on gestational weight gain were greater in women in the obese (MD, -1.63

kg) and overweight (MD, -0.89 kg) categories compared with women with normal prepregnancy BMI (MD, -0.48 kg; p=0.06 for BMI category interaction). Although average GWG differed according to prepregnancy BMI category, women with normal weight may experience greater relative benefit (percent change in overall BMI) for the same effects on weight gain compared with women categorized as obese (the IOM recommendations for GWG are higher [25-35 lbs.] in women with normal weight than in women in the obese category [11-20 lbs.]). Additionally, there were no statistically significant interactions between the type of intervention (counseling-only versus active, p=0.07) or timing of weight gain assessment (p=0.26) and effects of GWG interventions on the amount of weight gain.

GWG interventions also were associated with decreased likelihood of weight gain in excess of IOM recommendations versus controls. The absolute risk difference was approximately 8 percent, with the NNT to prevent one woman experiencing GWG in excess of IOM recommendations approximately 13. There were statistically significant interactions between effects of GWG interventions on likelihood of weight gain in excess of IOM recommendations and active interventions (p<0.001 for interaction) and high intensity interventions (p<0.001 for interaction), but not BMI category (p=0.50 for interaction).

There was no association between GWG interventions and likelihood of adhering to IOM recommendations for GWG (defined as neither gaining excess weight nor not gaining enough weight). The discrepancy between positive effects of GWG interventions on likelihood of gaining excess weight and no effect on likelihood of adhering to IOM recommendations could be explained by an increased likelihood of some women failing to gain enough weight. However, data were not available to verify this, as most studies did not report the proportion of women unable to gain sufficient weight. GWG interventions were associated with effects on postpartum weight retention at 12 months followup but not at less than 6 months or 6 months, although data were limited and estimates were imprecise.

Evidence on harms of GWG interventions was limited. Most studies were not designed to assess harms, though some reported outcomes unrelated to interventions (SGA, psychological outcomes) that could be considered either potential benefits or harms. Evidence on effects of GWG interventions on maternal depression and anxiety was limited and showed mixed results based on various symptom scales. There was no association between GWG interventions versus controls and risk of SGA. As noted above, studies did not report the proportion of women who failed to gain sufficient weight during pregnancy.

Reviews of observational studies evaluating associations between GWG interventions and maternal and infant outcomes were generally consistent with our findings,[21-23,172,173] although some differences could be explained by use of observational data. Importantly, our findings are generally consistent with obesity and behavioral intervention literature that demonstrates more promising effects of interventions that offer frequent patient contact, and for more pronounced effects on absolute weight loss in obese populations.[174,175]

Limitations

We excluded non-English language studies and did not search for studies published only as abstracts. There was substantial variability in interventions, comparisons, and timing and method of assessment of outcomes, with statistical heterogeneity in some pooled analysis that was only partially accounted for in stratified or subgroup analyses based on these and other factors. Because of anticipated heterogeneity, we performed random effects analyses, which resulted in wider confidence intervals than fixed effects models when statistical heterogeneity is present, reflecting the greater uncertainty in estimates. In addition, we used the profile-likelihood method for conducting meta-analysis, which may be more reliable when statistical heterogeneity is present.[176]

There were limitations in the evidence. There was a lack of data on prepregnancy weight loss interventions. One trial of a prepregnancy intervention showed that intentional weight loss prior to pregnancy did not impact adherence to weight gain guidelines during pregnancy and, instead, resulted in increased gestational weight gain.[116] One arm of a trial that focused on reducing GDM risk through a lifestyle intervention included women who were planning pregnancy. However, not all women in the intervention arm were encouraged to lose weight, and weight change before pregnancy was not reported, precluding the evaluation of the effects of prepregnancy weight loss on pregnancy outcomes.[137] Many individual trials had methodological limitations, though we excluded poor-quality trials due to serious flaws. Trials primarily focused on the effects of GWG interventions on mean GWG, an intermediate outcome, with less evidence on the direct effects of GWG interventions on maternal and infant health outcomes. Some of the subgroup analyses were underpowered to evaluate subgroup effects. Additionally, some trials enrolled mixed populations of women with different BMI categories, limiting the usefulness of stratified analyses. Evidence on harms was limited, particularly for effects on psychological well-being and quality of life. Most studies had some methodological limitations, though results were similar in analyses stratified by study quality.

Another limitation was inconsistent outcome measurement or characterization. For example, for studies of gestational diabetes, there was significant variation in diagnostic criteria. Maternal hemorrhage and infant outcomes (e.g., SGA) were also inconsistently defined. Studies reporting PPWR were limited by sparse data and lack of reporting on factors other than the GWG interventions that could influence PPWR (e.g., breastfeeding status, intentional weight loss efforts). For studies evaluating rates of cesarean delivery, indications for cesarean or emergency cesarean were not reported or were poorly defined (e.g., “failure to progress”). We pooled results separately for nonemergency or mixed cesarean section and emergency cesarean, with similar findings of no effects of GWG interventions on nonemergency cesarean, but statistically significant effects of interventions on emergency cesarean.

Emerging Issues/Next Steps

Given the lack of studies evaluating interventions to reduce weight before pregnancy, trials examining the impact of prepregnancy weight loss interventions are an important next step, and several are ongoing.[177-180] Importantly, for prepregnancy interventions to be effective it is

necessary to identify women who intend to become pregnant; therefore, studies that incorporate methods for evaluating pregnancy intention are needed for optimally implementing prepregnancy interventions.[116,181] For example, the One Key Question© initiative works to improve pregnancy outcomes based on the premise that providing clinicians with a framework to routinely assess pregnancy intention offers an opportunity for patient-centered counseling that can be tailored based on a woman's desire or ambivalence about pregnancy.[182]

Relevance for Priority Populations

Data were too limited to determine how effects of GWG interventions on health outcomes or weight-related outcomes varied in populations defined by race or ethnicity, age (e.g., adolescents, older maternal age), or socioeconomic status given that outcomes were not reported according to these groups. However, 28 of the 68 included studies (41%) enrolled more than 20 percent of patients from diverse backgrounds, including those who are socioeconomically disadvantaged, racial or ethnic minorities, rural populations, or others as defined by the National Institute on Minority Health and Health Disparities as populations adversely affected by disparities.[183] As such, the potential applicability of various interventions is favorable given the diversity of enrolled study populations. Although the reported ages of enrolled participants in study samples ranged from 14 to 49 years, studies did not include large numbers of women of advanced maternal age or did not report data separately in this subgroup. No study was specifically conducted in pregnant adolescents. Evidence suggests an association with increased risk in adolescent mothers for developing and maintaining unhealthy BMI during and after pregnancy, which can be intensified by GWG.[184] Excess GWG in pregnant adolescents may have lasting effects for future pregnancies and into adulthood.[185] Trials did not address issues of health care disparities, access to prenatal care (or lack thereof), or feasibility of interventions in settings where access to care is limited or arrival to care is delayed.

Future Research

Research is needed to determine the effectiveness of interventions to limit GWG in populations of women of advanced maternal age (e.g., older than 34 years), adolescents, and in the priority populations described above. While there were many studies on effects of interventions on GWG, the effects on maternal and infant health outcomes is more limited, as these were mostly reported as secondary outcomes of interventions to reduce GWG. A recently published consortium of trials (Lifestyle Interventions for Expectant Moms) found diverse behavioral intervention modalities implemented in a large, racially and socioeconomically diverse U.S. population of pregnant women were associated with modest, beneficial effect on GWG, but had no effects on health outcomes including preeclampsia, GDM, cesarean delivery, or birth weight.[57] At 12 months, they found beneficial effects on maternal postpartum weight retention but no effects on infant anthropometric outcomes.[177,186,187] Eligible trials from this consortium that were completed and published are included this review.[86,94,103,130,134,149] Future trials could evaluate more intensive behavioral interventions, which may be more effective, and whether components should be tailored to specific populations.[66] Research would be helpful for determining the optimal frequency, length of sessions, and number of sessions needed for an

intervention to provide additional evidence on effectiveness. Another consideration is whether GWG is the most appropriate outcome measure, or whether an alternative indicator of gestational weight, such as maternal fat accumulation or weight gain relative to prepregnancy BMI, is more informative. Given that GWG is a composite outcome influenced by many factors, causal relationships may be difficult to measure,[188] as are indirect links between maternal weight and perinatal outcomes.[189] Future trials of interventions to limit GWG should evaluate health outcomes using standardized measures of postpartum hemorrhage, gestational hypertension, preeclampsia, and gestational diabetes, and should report indications for cesarean delivery, as well as stratify effects of interventions by BMI category. Given the lack of data directly evaluating harms of interventions to limit GWG, further investigation into the potential harms related to these interventions, including the harms of insufficient weight gain, is needed. Other harms may include the effects of musculoskeletal injuries in women due to body changes occurring during the relatively short timeline of pregnancy.

Conclusions

Counseling and active behavioral interventions to limit GWG in pregnant women are associated with a modestly decreased risk of GDM, emergency cesarean delivery, macrosomia, and large for gestational age. GWG interventions are also associated with modest reductions in weight gain and decreased likelihood of exceeding IOM recommendations for GWG. Effects of these interventions on mean GWG are slightly more pronounced for high intensity interventions.

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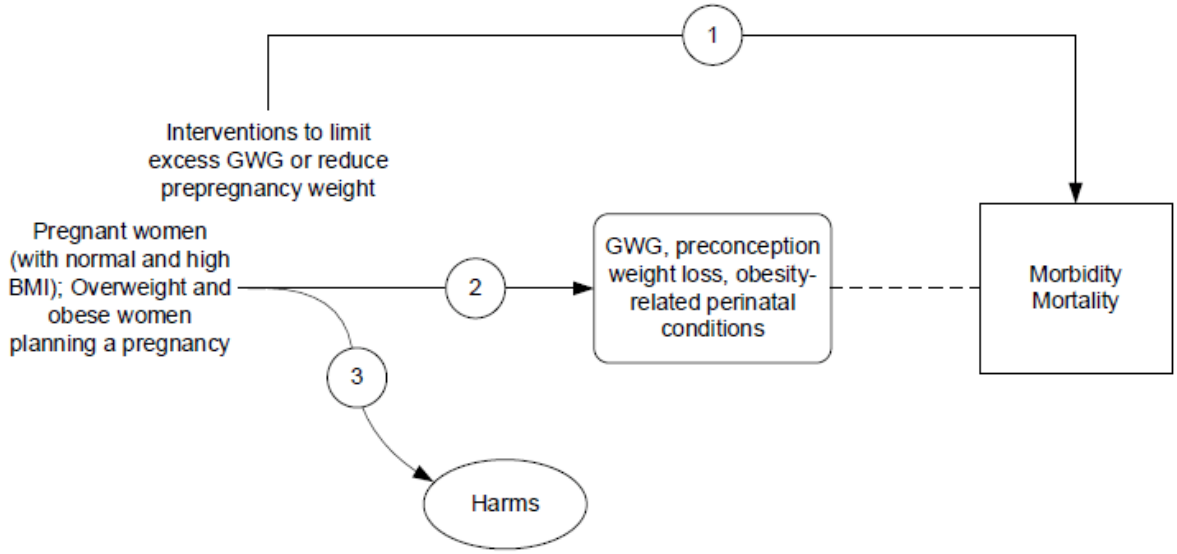
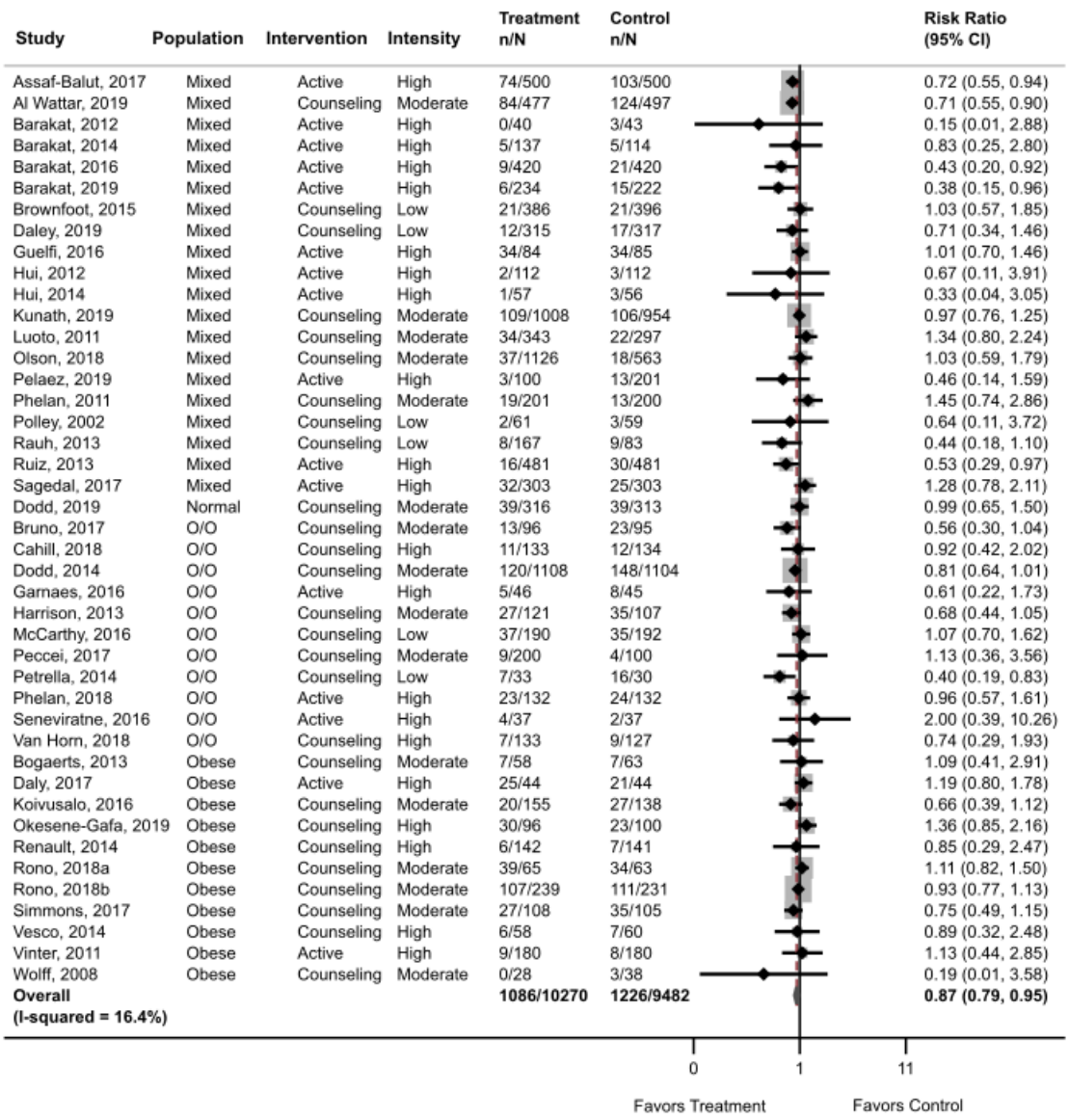
Figure 1. Analytic Framework and Key Questions



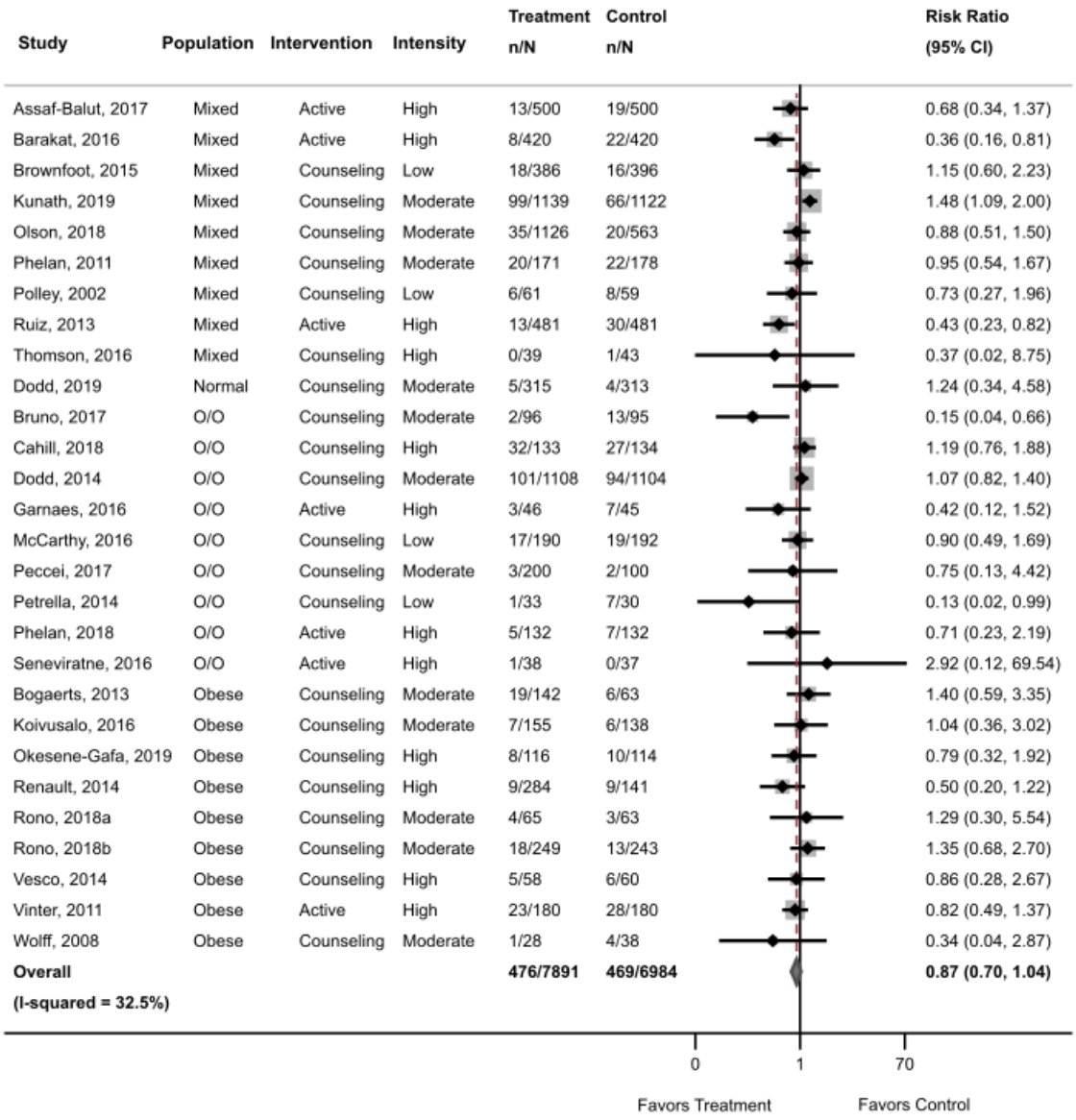
Abbreviations: BMI = body mass index; GWG = gestational weight gain.

Figure 2. Meta-Analysis of Trials: Gestational Diabetes Mellitus



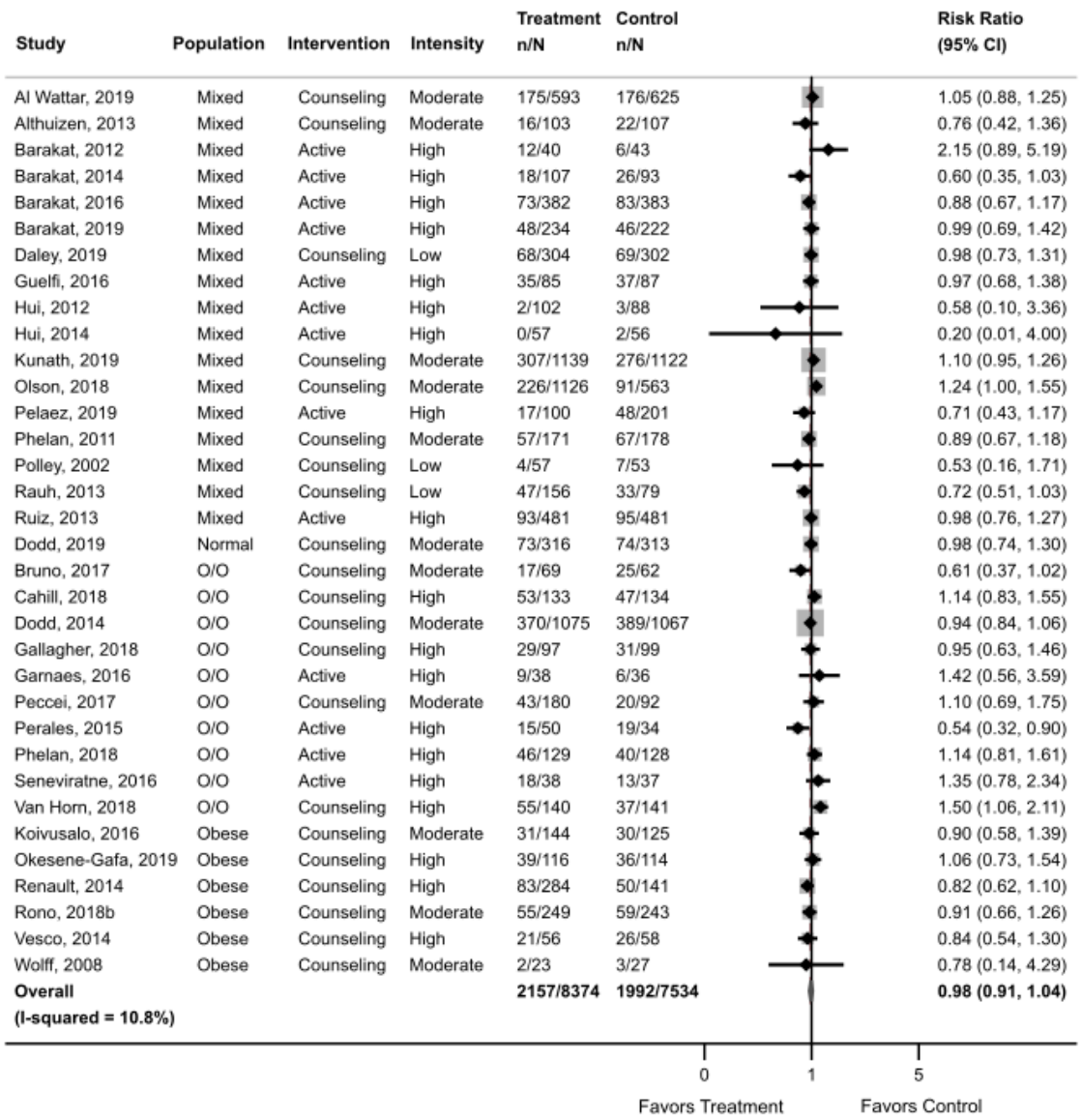
Abbreviations: CI = confidence interval; I-squared = test for heterogeneity using profile-likelihood estimate; O/O = overweight and obese combined BMI category.

Figure 3. Meta-Analysis of Trials: Gestational Hypertension



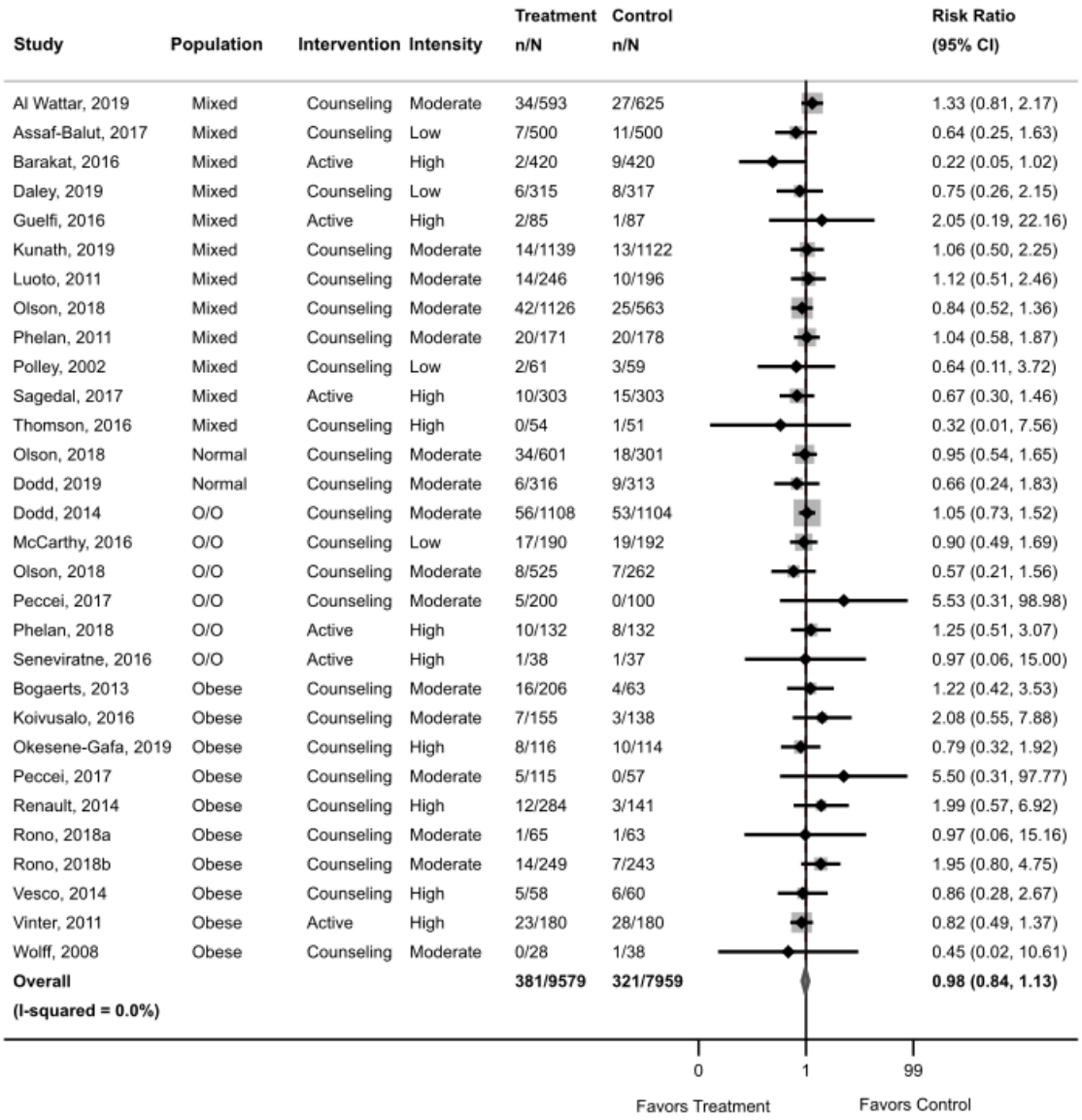
Abbreviations: CI = confidence interval; I-squared = test for heterogeneity using profile-likelihood estimate; O/O = overweight and obese combined BMI category.

Figure 4. Meta-Analysis of Trials: Cesarean Delivery*



* Any cesarean delivery outcome.
Abbreviations: CI = confidence interval; I-squared = test for heterogeneity using profile-likelihood estimate; O/O = overweight and obese combined BMI category.

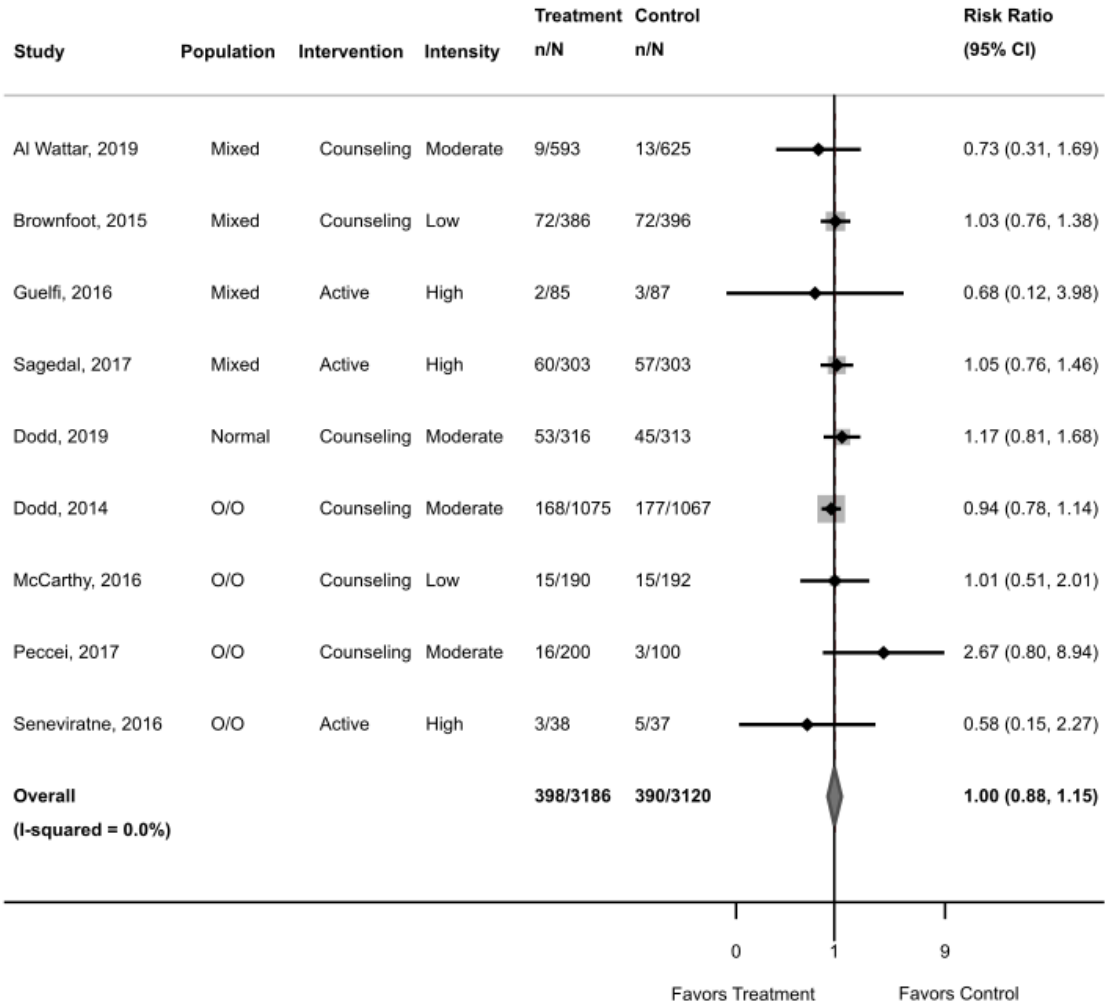
Figure 5. Meta-Analysis of Trials: Preeclampsia



Note: Some trials reported multiple discrete BMI subcategories.

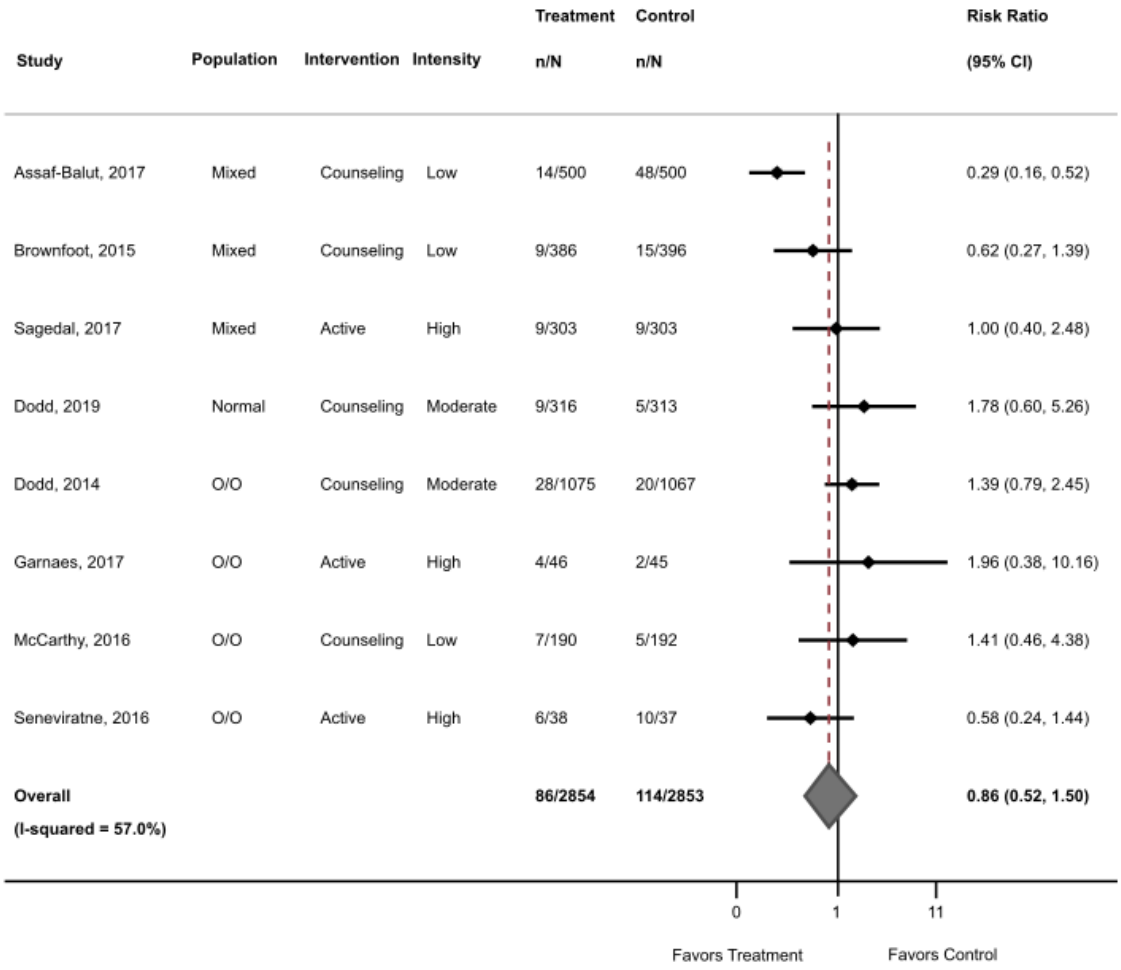
Abbreviations: CI = confidence interval; I-squared = test for heterogeneity using profile-likelihood estimate; O/O = overweight and obese combined BMI category.

Figure 6. Meta-Analysis of Trials: Postpartum Hemorrhage



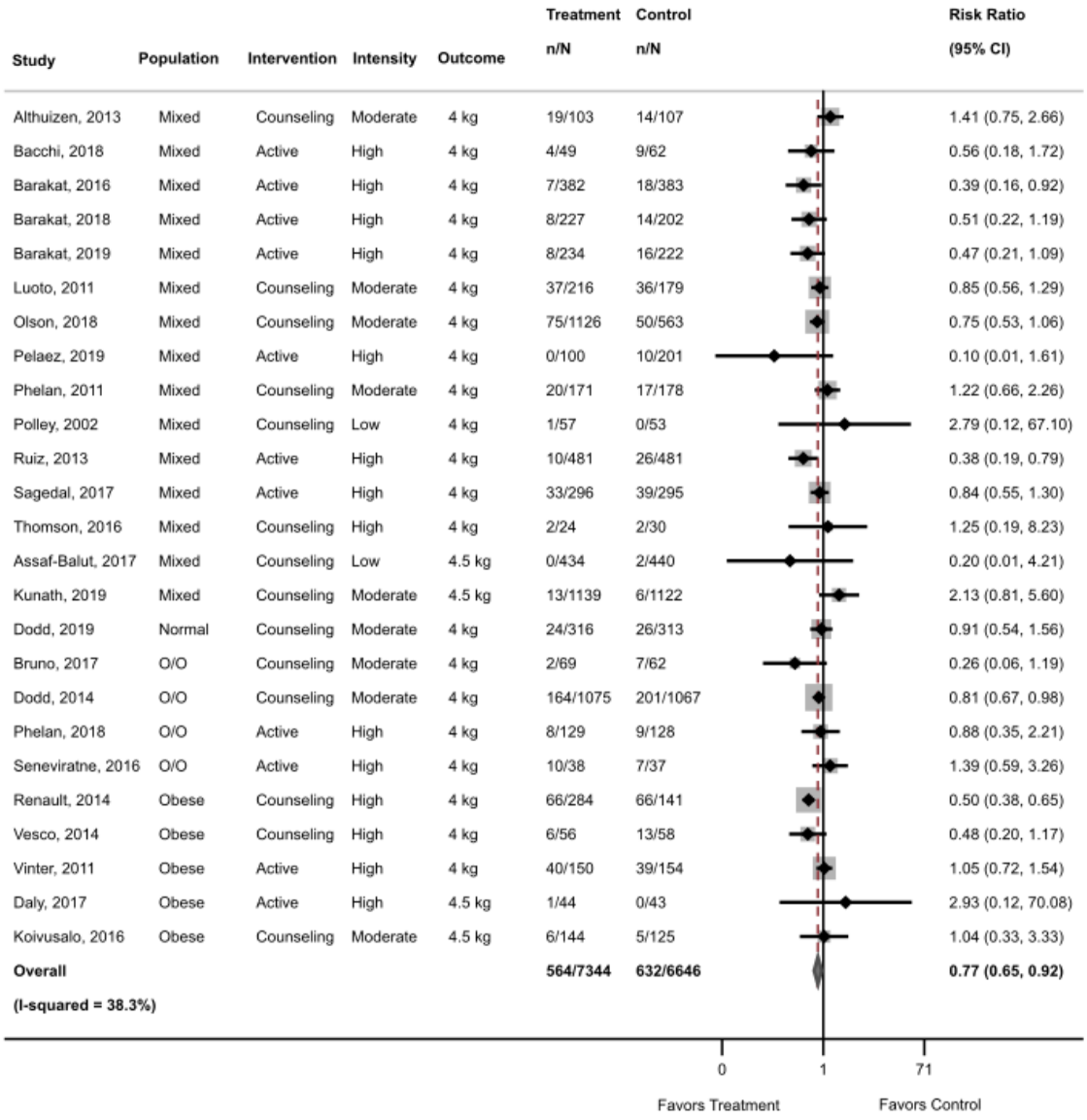
Abbreviations: CI = confidence interval; I-squared = test for heterogeneity using profile-likelihood estimate; O/O = overweight and obese combined BMI category.

Figure 8. Meta-Analysis of Trials: Macrosomia



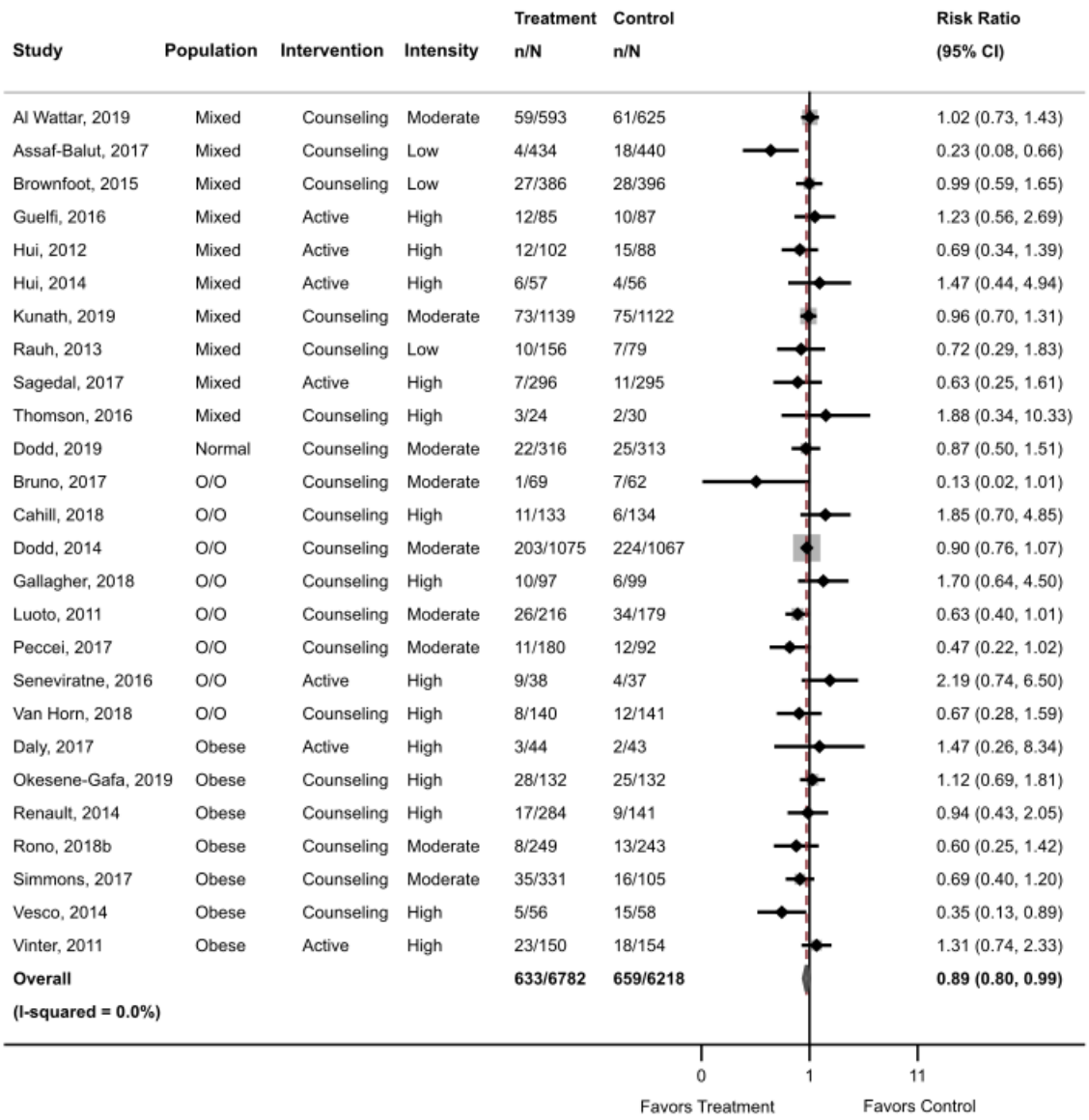
Abbreviations: CI = confidence interval; I-squared = test for heterogeneity using profile-likelihood estimate; O/O = overweight and obese combined BMI category.

Figure 8. Meta-Analysis of Trials: Macrosomia



Note: Outcome column reflects study definition of macrosomia as greater than 4 kg or 4.5 kg. Outcome with Dodd 2019 defining macrosomia as >4.5 kg: RR 0.76, 95% CI, 0.63 to 0.92, I^2=40%.
Abbreviations: CI = confidence interval; I-squared = test for heterogeneity using profile-likelihood estimate; O/O = overweight and obese combined BMI category.

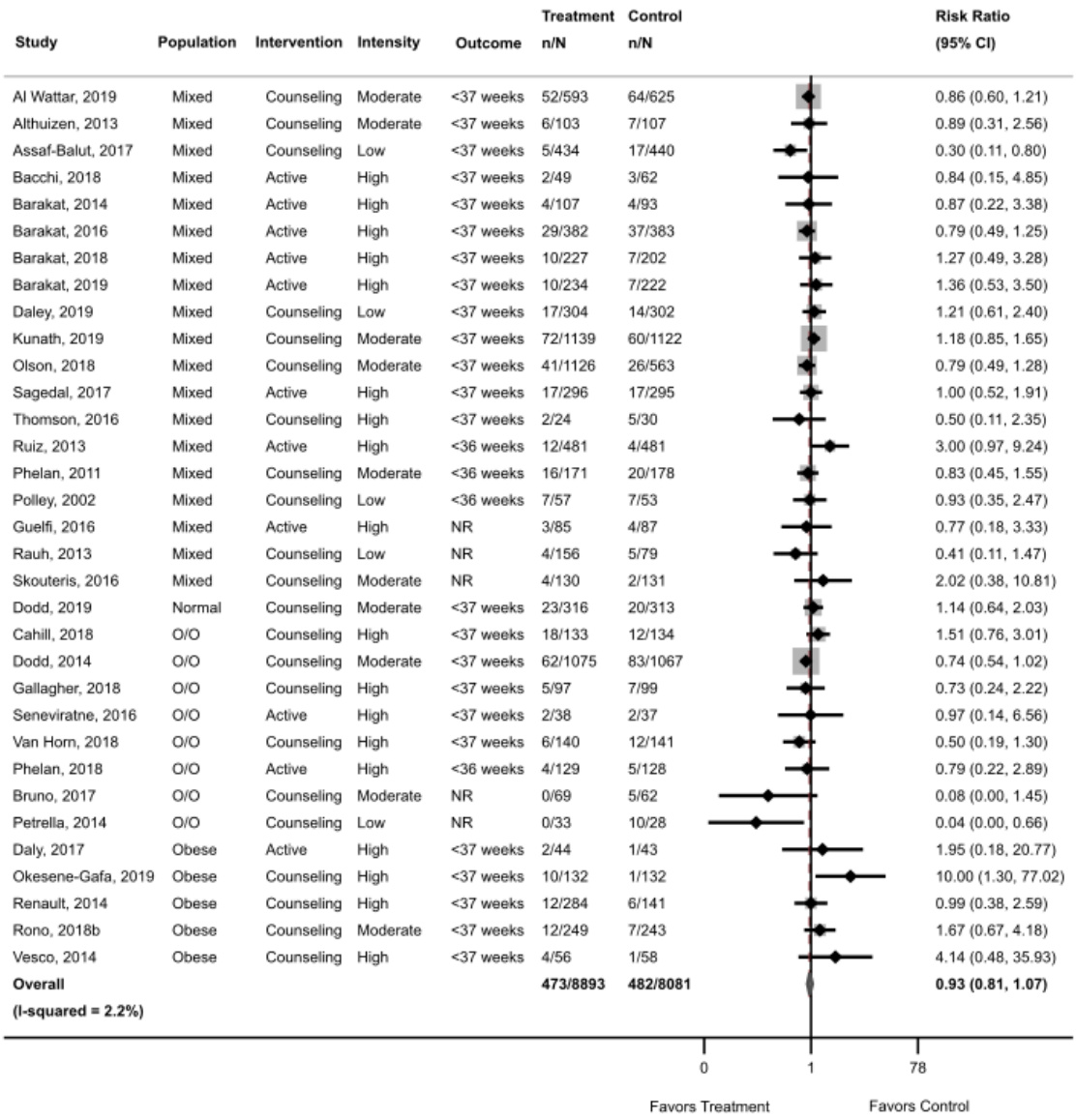
Figure 9. Meta-Analysis of Trials: Large for Gestational Age



Note: Large for gestational age defined as birthweight above the 90th percentile for gestational age.

Abbreviations: CI = confidence interval; I-squared = test for heterogeneity using profile-likelihood estimate; O/O = overweight and obese combined BMI category.

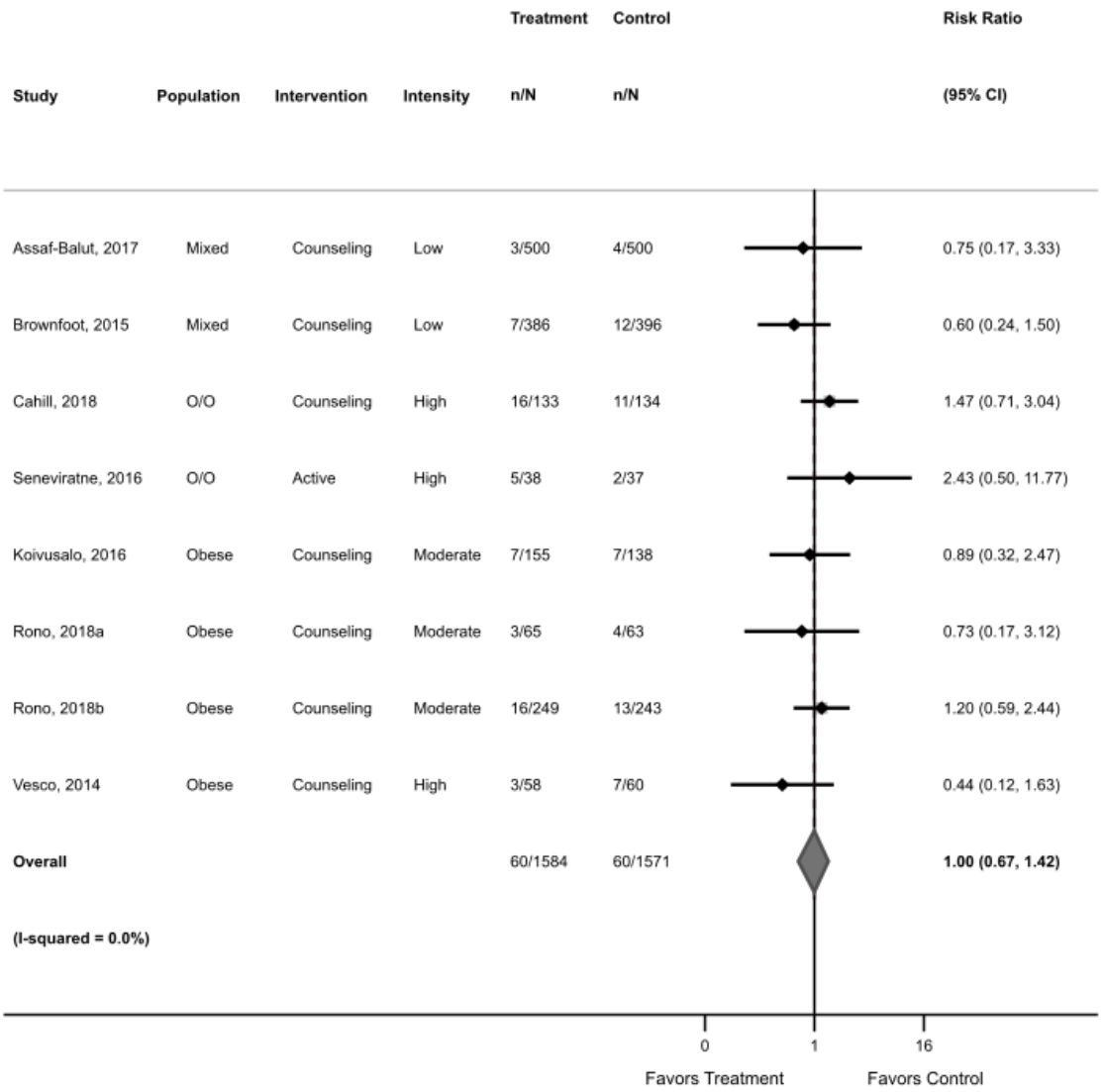
Figure 10. Meta-Analysis of Trials: Preterm Birth



Note: Outcome column reflects study definition of preterm birth as prior to 36 weeks' gestation (<36 w), 37 weeks' gestation (<37 w), or not reported.

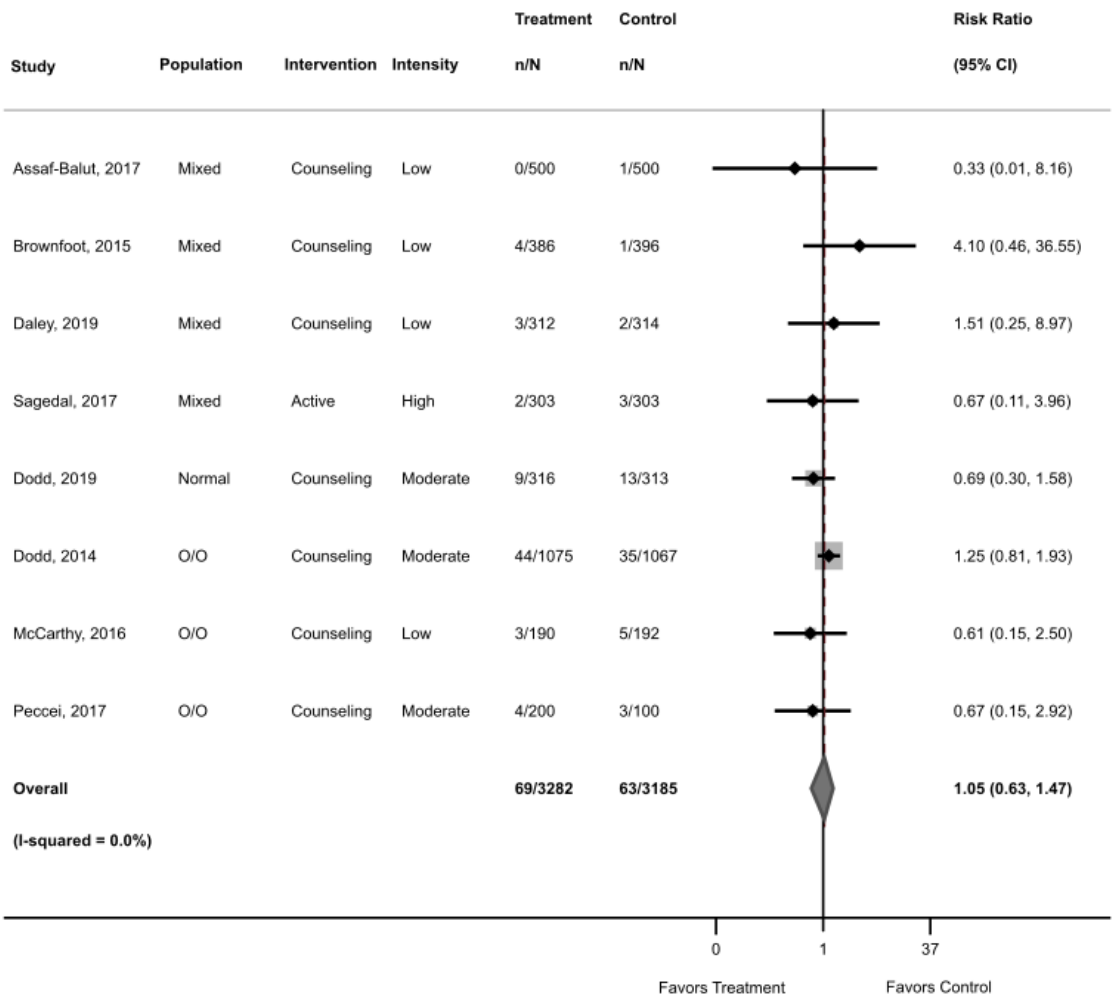
Abbreviations: CI = confidence interval; I-squared = test for heterogeneity using profile-likelihood estimate; NR = not reported; O/O = overweight and obese combined BMI category.

Figure 11. Meta-Analysis of Trials: Infant Respiratory Distress Syndrome



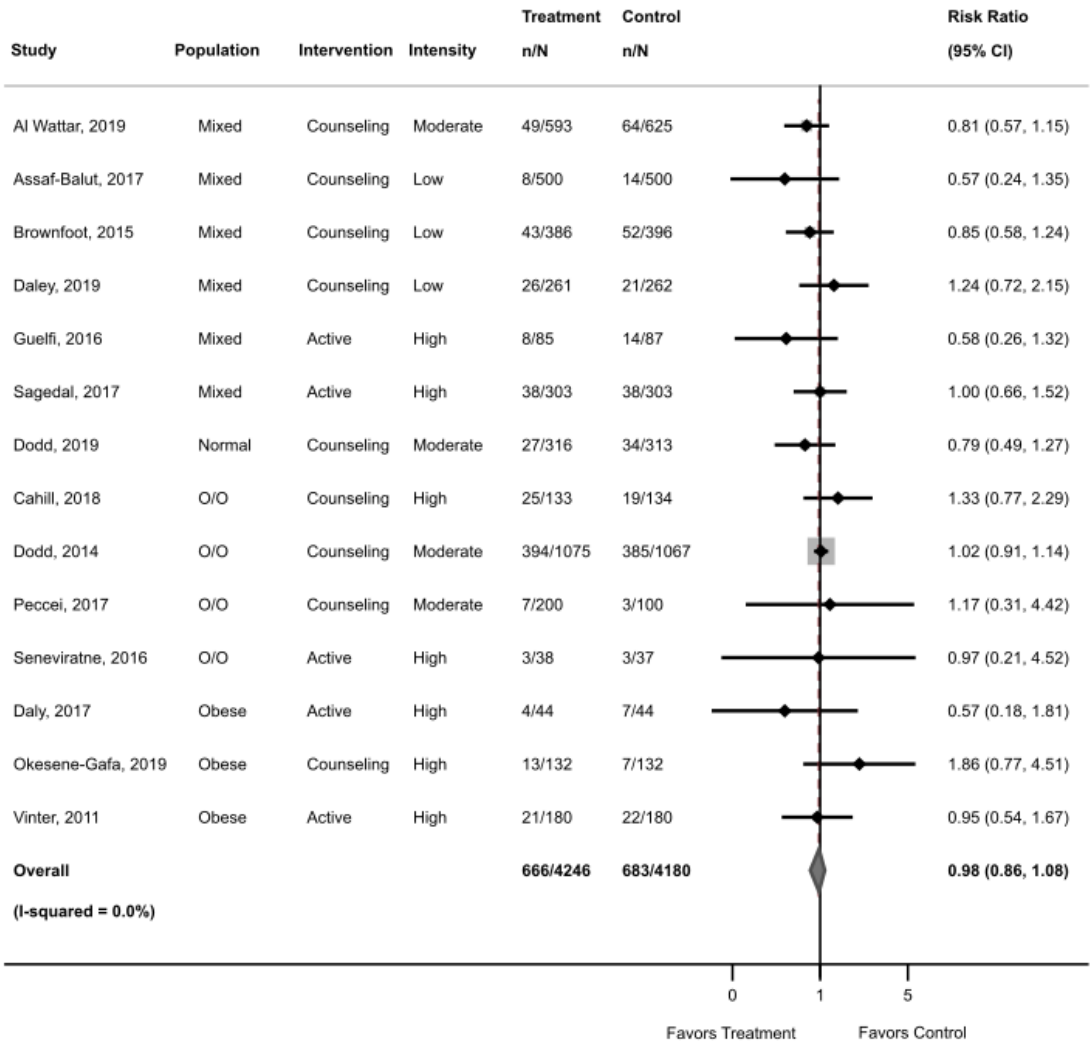
Abbreviations: CI = confidence interval; I-squared = test for heterogeneity using profile-likelihood estimate; O/O = overweight and obese combined BMI category.

Figure 12. Meta-Analysis of Trials: Shoulder Dystocia



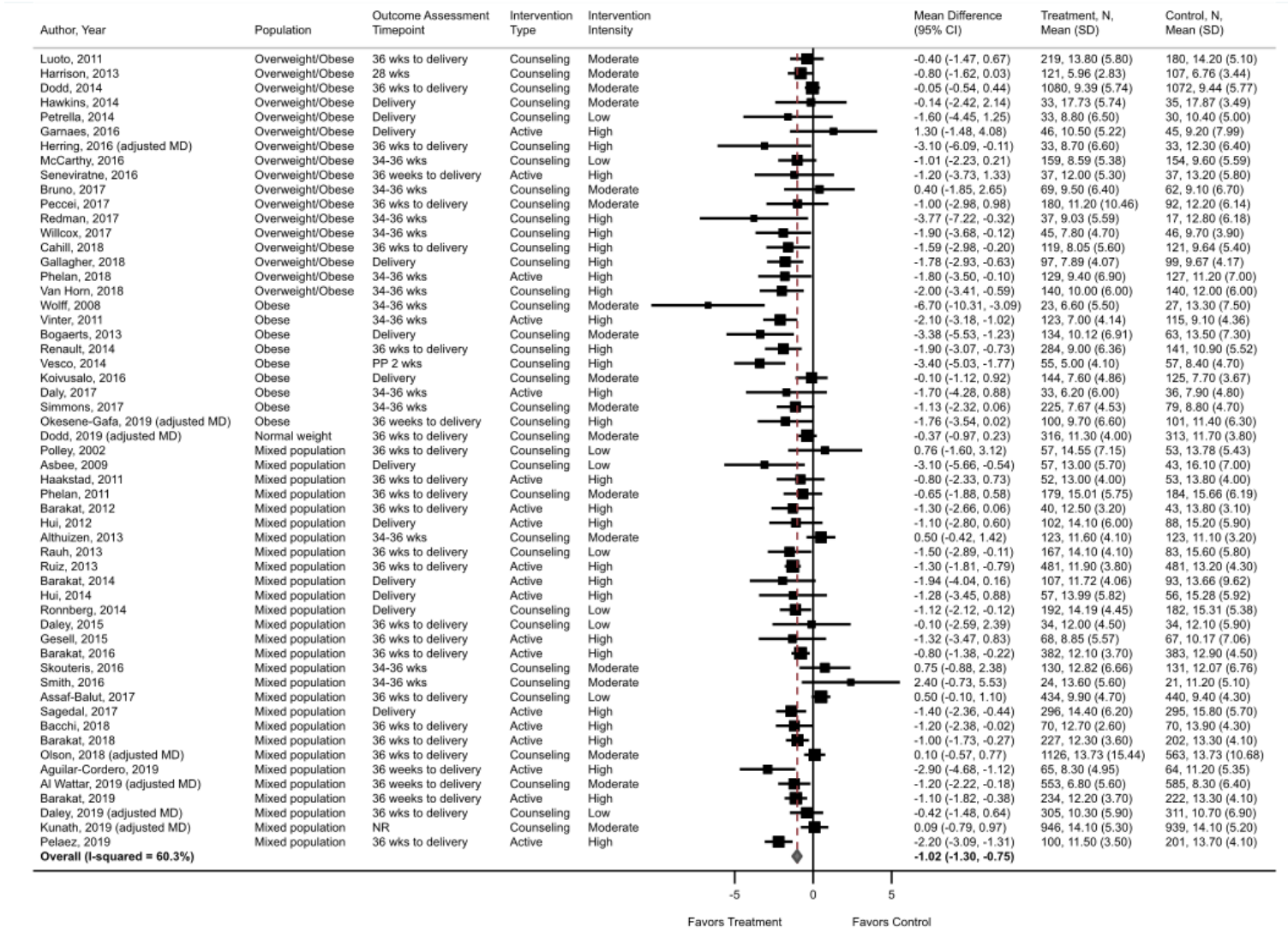
Abbreviations: CI = confidence interval; I-squared = test for heterogeneity using profile-likelihood estimate; O/O = overweight and obese combined BMI category.

Figure 13. Meta-Analysis of Trials: Neonatal Intensive Care Unit Admission



Abbreviations: CI = confidence interval; I-squared = test for heterogeneity using profile-likelihood estimate; O/O = overweight and obese combined BMI category.

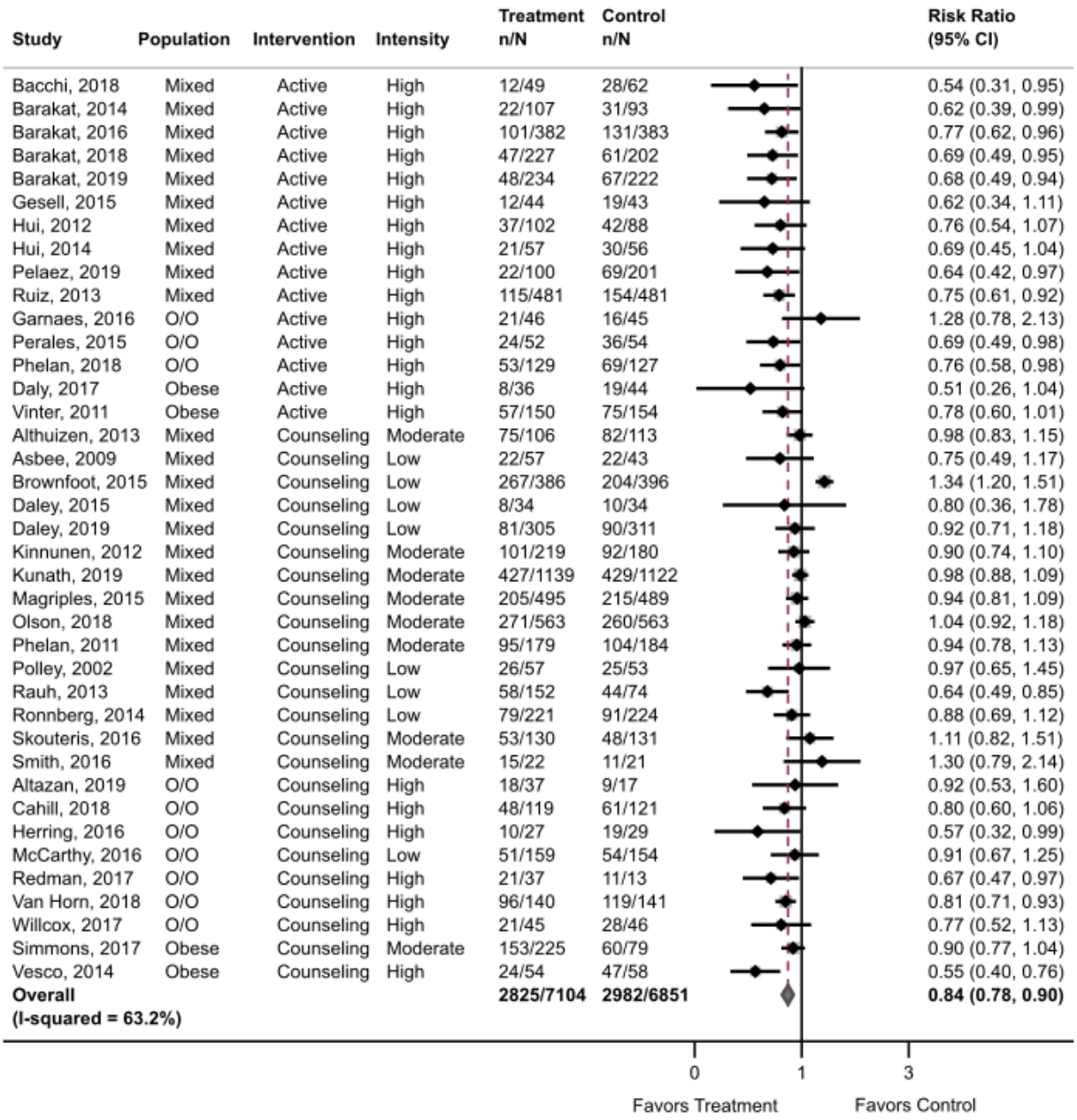
Figure 14. Meta-Analysis of Trials: Mean Gestational Weight Gain



Note: Outcome excluding Wolff, 2008: MD -0.99 kg, 95% CI, -1.26 to -0.73, I^2 = 58.8%, p<0.001.

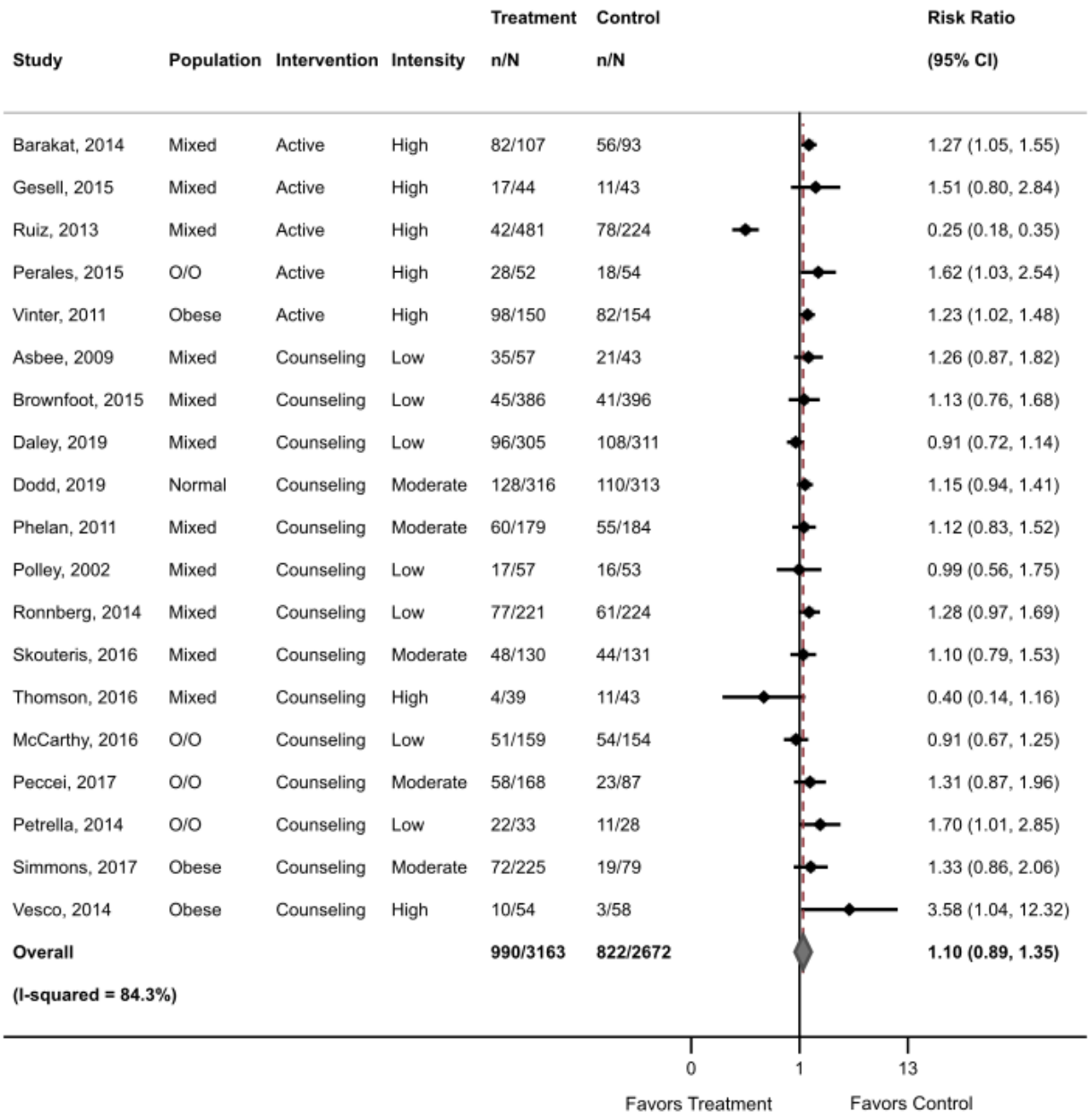
Abbreviations: CI = confidence interval; I-squared = test for heterogeneity using profile-likelihood estimate; MD = mean difference; N = number; NR = not reported; PP = postpartum; SD = standard deviation.

Figure 15. Meta-Analysis of Trials: Exceeding IOM Recommendations for Gestational Weight Gain



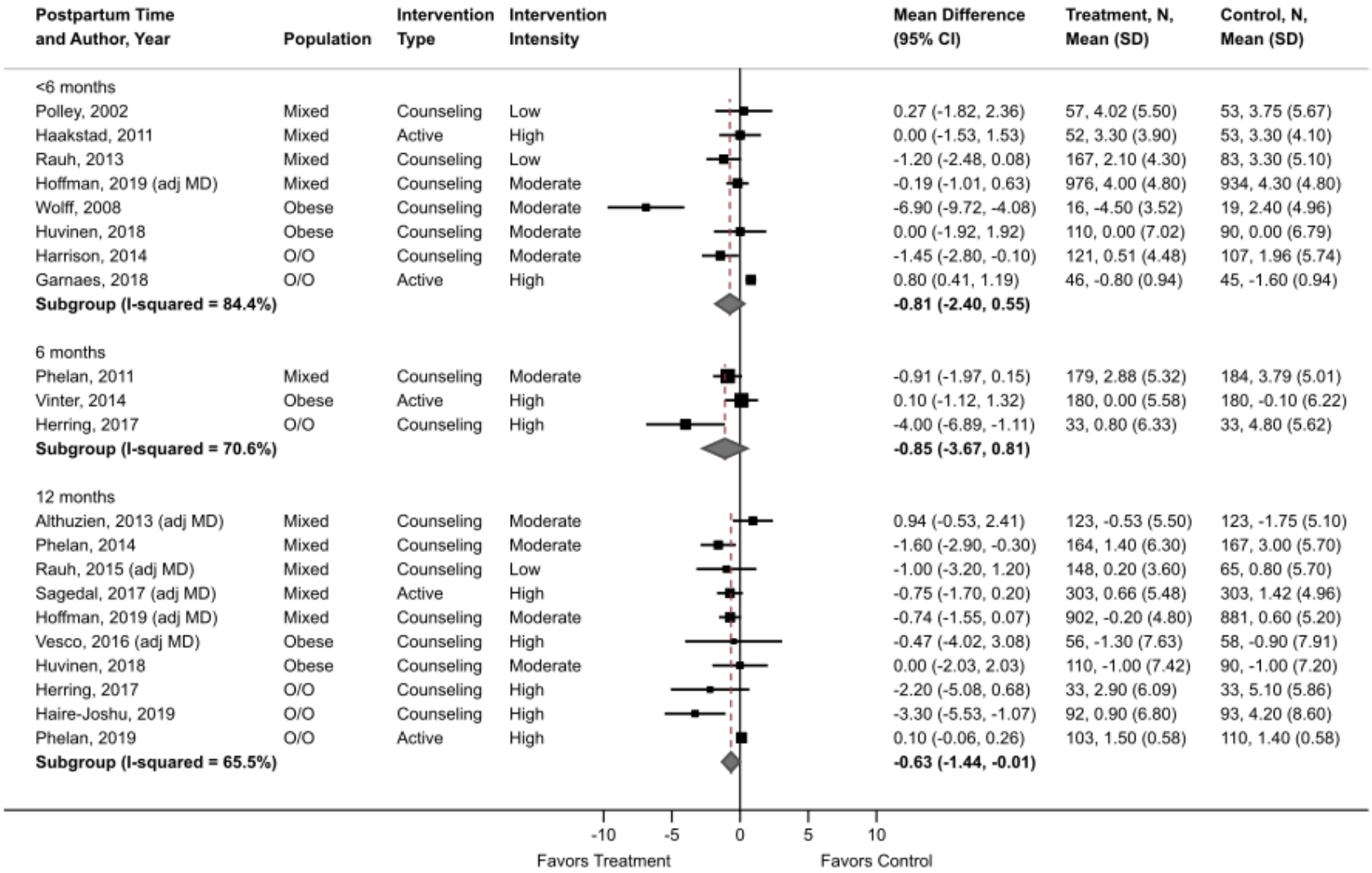
Abbreviations: CI = confidence interval; I-squared = test for heterogeneity using profile-likelihood estimate; IOM = Institute of Medicine; O/O = overweight and obese combined BMI category.

Figure 16. Meta-Analysis: Adherence to IOM Recommendations for Gestational Weight Gain



Abbreviations: CI = confidence interval; I-squared = test for heterogeneity using profile-likelihood estimate; IOM = Institute of Medicine; O/O = overweight and obese combined BMI category.

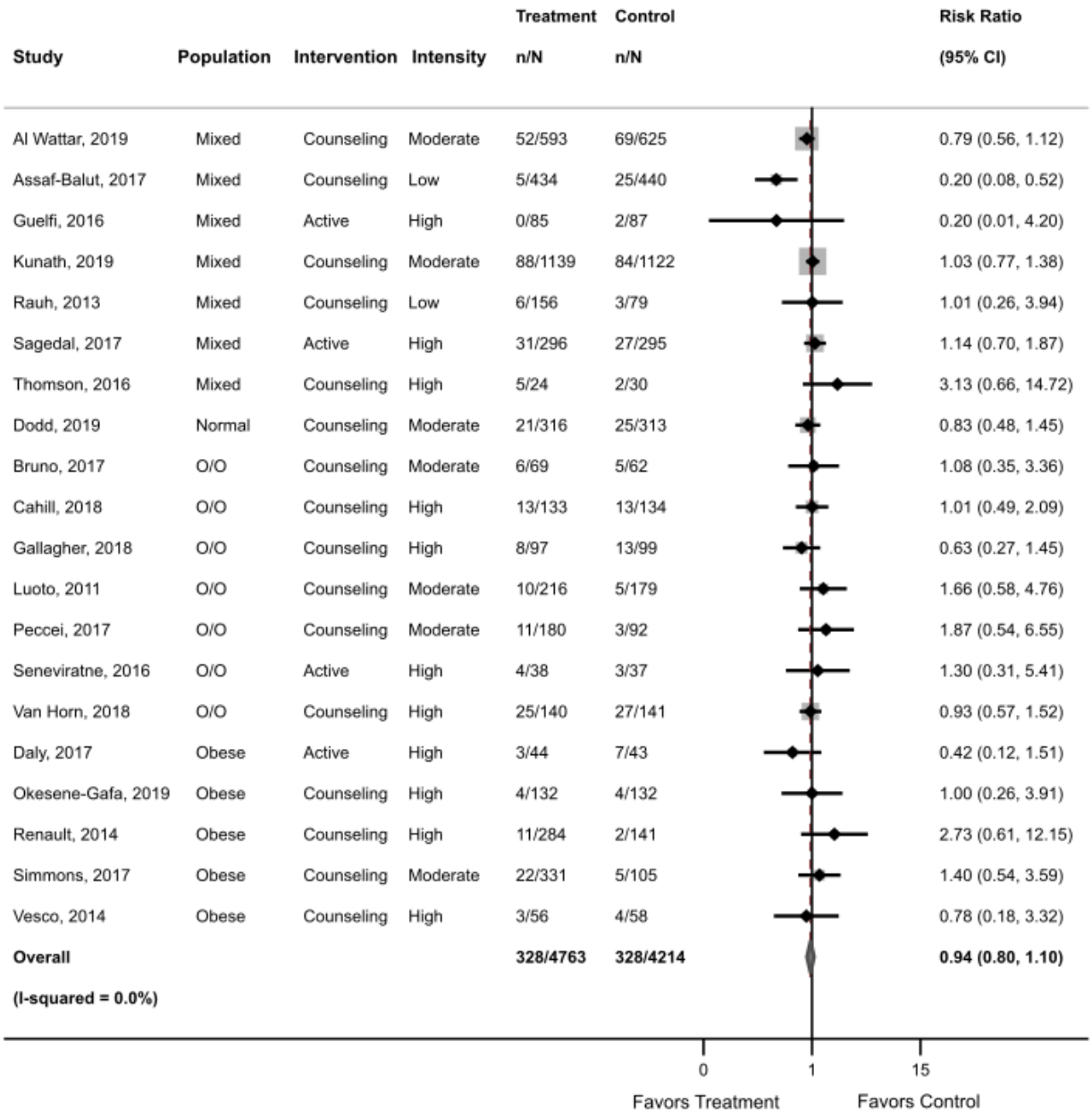
Figure 17. Meta-Analysis of Trials: Mean Postpartum Weight Retention



Note: Outcome (<6 months) excluding Wolff, 2008: MD -0.17 kg, 95% CI, -0.97 to 0.53, I^2 = 69.5%, p=0.003.

Abbreviations: CI = confidence interval; I-squared = test for heterogeneity using profile-likelihood estimate; O/O = overweight and obese combined BMI category; N = number; SD = standard deviation.

Figure 18. Meta-Analysis of Trials: Small for Gestational Age



Note: Small for gestational age defined as birthweight below the 10th percentile for gestational age.

Abbreviations: CI = confidence interval; I-squared = test for heterogeneity using profile-likelihood estimate; O/O = overweight and obese combined BMI category.

Table 1. Recommendations Made by Organizations Regarding Obesity in Pregnancy and Gestational Weight Gain

Organization	Year	Title	Recommendation
American College of Obstetricians and Gynecologists[3]	2013, 2016	Committee Opinion Number 548: Weight Gain During Pregnancy Committee Opinion Number 591: Challenges for Overweight and Obese Women	Recommends nutrition assessment and counseling during preconception and prenatal visits, including counseling on nutrition, exercise, and weight gain based on height and prepregnancy weight.[190] Health care providers who care for pregnant women should determine a woman's BMI at the initial prenatal visit. It is important to discuss appropriate weight gain, diet, and exercise at the initial visit and periodically throughout the pregnancy. Individualized care and clinical judgment are necessary in managing overweight or obese women who are gaining (or wish to gain) less weight than recommended but have an appropriately growing fetus. Balancing the risks of fetal growth, obstetric complications, and maternal weight retention is essential but will remain challenging until research provides evidence to further refine the recommendations for GWG, especially among women with high degrees of obesity.
National Institute for Health and Care Excellence[191]	2010	Weight Management Before, During and After Pregnancy	Women with a BMI greater than or equal to 30 kg/m^2 who may become pregnant should be told that their weight poses a risk and should be advised about the health benefits of losing weight before pregnancy and referred to weight loss support programming. Women with a BMI of 30 kg/m^2 or greater when pregnant should be advised of the risk but that they should not diet during pregnancy. These women should be offered a referral to a dietician or appropriately trained health professional for assessment and personalized advice on healthy eating and physical activity.
Centre for Maternal and Child Enquiries & Royal College of Obstetricians and Gynaecologists[192]	2010	Joint Guideline: Management of Women with Obesity in Pregnancy	All pregnant women with a booking BMI greater than or equal to 30 kg/m^2 should be provided with accurate and accessible information about the risks associated with obesity in pregnancy and how they may be minimized. Women should be given the opportunity to discuss this information.
Society of Obstetricians and Gynaecologists of Canada[193]	2010	Clinical Practice Guideline Number 239: Obesity in Pregnancy	Pregnant women with a prepregnancy BMI greater than 30 kg/m^2 should receive counseling about weight gain, nutrition, food choices, and the risks to themselves and their fetus associated with obesity.
Institute of Medicine[1]	2009	Weight Gain During Pregnancy: Reexamining the Guidelines	Recommends that providers of prenatal care should offer women counseling, such as guidance on dietary intake and physical activity that is tailored to their life circumstances. Federal, State, and local agencies, as well as health care providers, should inform women of the importance of conceiving at a normal BMI, and those who provide healthcare or related services to women of childbearing age should include preconception counseling in their care.

Abbreviations: BMI = body mass index (kilograms per meter squared); GWG = gestational weight gain.

Table 2. Meta-Analysis of Trials: Gestational Diabetes Mellitus Stratified Analysis

Stratified Analysis	Category	Number of Trials	RR (95% Confidence Interval)	I^2	p for Subgroup Interaction
Study Population	Overall	43	0.87 (0.79 to 0.95)	16.4%	NA
BMI Category	Normal only	1	0.99 (0.65 to 1.50)	NA	0.14
	Overweight only	0	NA	NA	
	Obese only	11	0.98 (0.84 to 1.13)	0%	
	Overweight-obese combined	11	0.80 (0.67 to 0.94)	0%	
	Mixed	20	0.83 (0.69 to 0.97)	26.5%	
Intervention Intensity	Low	6	0.75 (0.47 to 1.08)	29%	0.92
	Moderate	16	0.88 (0.79 to 0.99)	9.8%	
	High	21	0.86 (0.70 to 1.03)	22.9%	
Intervention Type	Active	15	0.82 (0.63 to 1.01)	26.3%	0.68
	Counseling-only	25	0.88 (0.80 to 0.98)	11%	

Abbreviations: BMI = body mass index; I^2 = index of heterogeneity; NA = not applicable; RR = relative risk.

Table 3. Meta-Analysis of Trials: Gestational Hypertension Stratified Analysis

Stratified Analysis	Category	Number of Trials	RR (95% Confidence Interval)	I^2	p for Subgroup Interaction
Study Population	Overall	28	0.87 (0.70 to 1.04)	32.5%	NA
BMI Category	Normal only	6	0.46 (0.21 to 0.93)	40.8%	0.08
	Overweight only	2	0.71 (0.25 to 2.06)	0%	
	Obese only	10	0.93 (0.70 to 1.25)	0%	
	Overweight-obese combined	12	0.98 (0.67 to 1.18)	0%	
	Mixed	9	0.81 (0.54 to 1.14)	55%	
Intervention Intensity	Low	4	0.89 (0.48 to 1.33)	0%	0.006
	Moderate	12	1.12 (0.86 to 1.35)	5.3%	
	High	12	0.69 (0.50 to 0.91)	23.5%	
Intervention Type	Active	7	0.60 (0.41 to 0.82)	0%	<0.001
	Counseling only	21	1.05 (0.84 to 1.23)	7.1%	

Abbreviations: BMI = body mass index; I^2 = index of heterogeneity; NA = not applicable; RR = relative risk.

Table 4. Meta-Analysis of Trials: Cesarean Delivery Stratified Analysis

Stratified Analysis	Category	Number of Trials	RR (95% Confidence Interval)	I^2	p for Subgroup Interaction
Study Population	Cesarean (type not specified)*	34	0.98 (0.91 to 1.04)	10.8%	NA
	Emergency Cesarean	13	0.87 (0.75 to 0.98)	0%	NA
BMI Category	Normal only	5	1.02 (0.81 to 1.27)	0%	0.70
	Overweight only	3	0.78 (0.44 to 1.34)	23%	
	Obese only	9	0.98 (0.82 to 1.21)	13%	
	Overweight-obese combined	15	1.02 (0.89 to 1.16)	24%	
	Mixed	17	0.98 (0.87 to 1.07)	15.4%	
Intervention Intensity	Low	3	0.85 (0.57 to 1.12)	0%	0.37
	Moderate	12	1.00 (0.91 to 1.08)	6.9%	
	High	19	0.97 (0.87 to 1.09)	15.8%	
Intervention Type	Active	13	0.94 (0.81 to 1.07)	0%	0.37
	Counseling only	21	0.99 (0.91 to 1.06)	13.3%	

* Reported as any cesarean delivery (type not specified), excluding emergency or elective. Stratified analyses (BMI, intervention intensity and type) conducted only for type not specified.

Abbreviations: BMI = body mass index; I^2 = index of heterogeneity; NA = not applicable; RR = relative risk.

Table 5. Meta-Analysis of Trials: Preeclampsia Stratified Analysis

Stratified Analysis	Category	Number of Trials	RR (95% Confidence Interval)	I^2	p for Subgroup Interaction
Study Population	Overall	27	0.98 (0.84 to 1.13)	0%	NA
BMI Category	Normal only	2	0.87 (0.43 to 1.55)	0%	0.86
	Overweight only	0	NA	NA	
	Obese only	10	1.09 (0.79 to 1.70)	0%	
	Overweight-obese combined	6	1.00 (0.73 to 1.35)	0%	
	Mixed	12	0.93 (0.72 to 1.17)	0%	
Intervention Intensity	Low	4	0.79 (0.48 to 1.24)	0%	0.29
	Moderate	16	1.06 (0.89 to 1.27)	0%	
	High	10	0.84 (0.62 to 1.16)	0%	
Intervention Type	Active	6	0.80 (0.52 to 1.19)	0%	0.25
	Counseling only	24	1.01 (0.86 to 1.19)	0%	

Note: Some trials reported multiple discrete populations. Overall number of trials reflects number of unique trials.
Abbreviations: BMI = body mass index; I^2 = index of heterogeneity; NA = not applicable; RR = relative risk.

Table 6. Meta-Analysis of Trials: Postpartum Hemorrhage Stratified Analysis

Stratified Analysis	Category	Number of Trials	RR (95% Confidence Interval)	I^2	p for Subgroup Interaction
Study Population	Overall	9	1.00 (0.88 to 1.15)	0%	NA
BMI Category	Normal only	1	1.17 (0.81 to 1.68)	NA	0.65
	Overweight only	0	NA	NA	
	Obese only	0	NA	NA	
	Overweight-obese combined	4	0.96 (0.77 to 1.35)	0%	
	Mixed	4	1.01 (0.78 to 1.25)	0%	
Intervention Intensity	Low	2	1.02 (0.72 to 1.45)	0%	0.99
	Moderate	4	0.99 (0.83 to 1.34)	0%	
	High	3	1.01 (0.53 to 1.46)	0%	
Intervention Type	Active	3	1.01 (0.53 to 1.46)	0%	1.00
	Counseling only	6	1.00 (0.87 to 1.20)	0%	

Abbreviations: BMI = body mass index; I^2 = index of heterogeneity; NA = not applicable; RR = relative risk.

Table 7. Meta-Analysis of Trials: Perineal Trauma Stratified Analysis

Stratified Analysis	Category	Number of Trials	RR (95% Confidence Interval)	I^2	p for Subgroup Interaction
Study Population	Overall	8	0.86 (0.52 to 1.50)	57.0%	NA
BMI Category	Normal only	1	1.78 (0.60 to 5.26)	NA	0.003
	Overweight only	0	NA	NA	
	Obese only	0	NA	NA	
	Overweight-obese combined	4	1.18 (0.66 to 2.01)	0%	
	Mixed	3	0.51 (0.24 to 1.28)	46.3%	
Intervention Intensity	Low	3	0.54 (0.22 to 1.67)	54%	0.003
	Moderate	2	1.47 (0.81 to 2.90)	0%	
	High	3	0.86 (0.45 to 1.95)	0%	
Intervention Type	Active	3	0.86 (0.45 to 1.95)	0%	0.73
	Counseling only	5	0.85 (0.41 to 1.89)	69.5%	

Abbreviations: BMI = body mass index; I^2 = index of heterogeneity; NA = not applicable; RR = relative risk.

Table 8. Meta-Analysis of Trials: Macrosomia Stratified Analysis

Stratified Analysis	Category	Number of Trials	RR (95% Confidence Interval)	I^2	p for Subgroup Interaction
Study Population	Overall	25	0.77 (0.65 to 0.92)	38.3%	NA
BMI Category	Normal only	5	0.73 (0.51 to 1.30)	0%	0.24
	Overweight only	0	NA	NA	
	Obese only	3	1.00 (0.68 to 1.26)	0%	
	Overweight-obese combined	7	0.83 (0.68 to 1.04)	0%	
	Mixed	14	0.76 (0.56 to 0.93)	0%	
Intervention Intensity	Low	2	0.71 (0.03 to 19.79)	0%	0.03
	Moderate	9	0.86 (0.75 to 1.08)	0%	
	High	14	0.65 (0.49 to 0.84)	37%	
Intervention Type	Active	11	0.70 (0.49 to 0.94)	30.7%	1.00
	Counseling only	14	0.82 (0.65 to 1.07)	45.6%	

Abbreviations: BMI = body mass index; I^2 = index of heterogeneity; NA = not applicable; RR = relative risk.

Table 9. Meta-Analysis of Trials: Large for Gestational Age Stratified Analysis

Stratified Analysis	Category	Number of Trials	RR (95% Confidence Interval)	I^2	p for Subgroup Interaction
Study Population	Overall	26	0.89 (0.80 to 0.99)	0%	NA
BMI Category	Normal only	1	0.87 (0.64 to 1.27)	NA	0.98
	Overweight only	0	NA	NA	
	Obese only	7	0.88 (0.59 to 1.19)	12%	
	Overweight-obese combined	8	0.87 (0.64 to 1.20)	0%	
	Mixed	10	0.92 (0.75 to 1.11)	0%	
Intervention Intensity	Low	3	0.64 (0.22 to 1.49)	46%	0.22
	Moderate	9	0.86 (0.71 to 0.97)	0%	
	High	14	1.05 (0.83 to 1.34)	0%	
Intervention Type	Active	7	1.10 (0.78 to 1.59)	0%	0.18
	Counseling only	19	0.87 (0.75 to 0.97)	0%	

Note: Large for gestational age defined as birthweight above the 90th percentile for gestational age.
Abbreviations: BMI = body mass index; I^2 = index of heterogeneity; NA = not applicable; RR = relative risk.

Table 10. Meta-Analysis of Trials: Preterm Birth Stratified Analysis

Stratified Analysis	Category	Number of Trials	RR (95% Confidence Interval)	I^2	p for Subgroup Interaction
Study Population	Overall	33	0.93 (0.81 to 1.07)	2.2%	NA
BMI Category	Normal only	1	1.14 (0.64 to 2.03)	NA	0.10
	Overweight only	0	NA	NA	
	Obese only	5	1.72 (0.95 to 4.78)	0%	
	Overweight-obese combined	8	0.77 (0.47 to 1.07)	0%	
	Mixed	19	0.94 (0.79 to 1.09)	0%	
Intervention Intensity	Low	5	0.58 (0.20 to 1.17)	43%	0.42
	Moderate	10	0.92 (0.77 to 1.12)	4.6%	
	High	18	1.03 (0.81 to 1.35)	0%	
Intervention Type	Active	11	1.01 (0.76 to 1.43)	0%	0.56
	Counseling only	22	0.91 (0.77 to 1.07)	6.2%	

Abbreviations: BMI = body mass index; I^2 = index of heterogeneity; NA = not applicable; RR = relative risk.

Table 11. Meta-Analysis of Trials: Infant Respiratory Distress Syndrome Stratified Analysis

Stratified Analysis	Category	Number of Trials	RR (95% Confidence Interval)	I^2	p for Subgroup Interaction
Study Population	Overall	8	1.00 (0.67 to 1.42)	0%	NA
BMI Category	Normal only	0	NA	NA	0.19
	Overweight only	0	NA	NA	
	Obese only	4	0.91 (0.48 to 1.50)	0%	
	Overweight-obese combined	2	1.60 (0.72 to 4.32)	0%	
	Mixed	2	0.64 (0.25 to 1.69)	0%	
Intervention Intensity	Low	2	0.64 (0.25 to 1.69)	0%	0.42
	Moderate	3	1.03 (0.54 to 1.80)	0%	
	High	3	1.23 (0.45 to 2.93)	0%	
Intervention Type	Active	1	2.43 (0.50 to 11.77)	NA	0.25
	Counseling only	7	0.95 (0.61 to 1.37)	0%	

Abbreviations: BMI = body mass index; I^2 = index of heterogeneity; NA = not applicable; RR = relative risk.

Table 12. Meta-Analysis of Trials: Shoulder Dystocia Stratified Analysis

Stratified Analysis	Category	Number of Trials	RR (95% Confidence Interval)	I^2	p for Subgroup Interaction
Study Population	Overall	8	1.05 (0.63 to 1.47)	0%	NA
BMI Category	Normal only	1	0.69 (0.30 to 1.58)	NA	0.55
	Overweight only	0	NA	NA	
	Obese only	0	NA	NA	
	Overweight-obese combined	3	1.12 (0.75 to 1.68)	0%	
	Mixed	4	1.22 (0.44 to 3.44)	0%	
Intervention Intensity	Low	4	1.06 (0.41 to 2.74)	0%	0.89
	Moderate	3	1.06 (0.73 to 1.55)	0%	
	High	1	0.67 (0.11 to 3.96)	0%	
Intervention Type	Active	1	0.67 (0.11 to 3.96)	NA	0.61
	Counseling only	7	1.06 (0.75 to 1.51)	0%	

Abbreviations: BMI = body mass index; I^2 = index of heterogeneity; NA = not applicable; RR = relative risk.

Table 13. Meta-Analysis of Trials: NICU Admission Stratified Analysis

Stratified Analysis	Category	Number of Trials	RR (95% Confidence Interval)	I^2	p for Subgroup Interaction
Study Population	Overall	14	0.98 (0.86 to 1.08)	0%	NA
BMI Category	Normal only	1	0.79 (0.49 to 1.27)	NA	0.38
	Overweight only	0	NA	NA	
	Obese only	3	1.04 (0.84 to 1.12)	0%	
	Overweight-obese combined	4	1.03 (0.89 to 1.31)	0%	
	Mixed	6	0.87 (0.71 to 1.06)	0%	
Intervention Intensity	Low	3	0.90 (0.59 to 1.32)	0%	0.82
	Moderate	4	0.98 (0.76 to 1.10)	0%	
	High	7	1.02 (0.78 to 1.32)	0%	
Intervention Type	Active	5	0.89 (0.61 to 1.19)	0%	0.47
	Counseling only	9	0.99 (0.86 to 1.10)	0%	

Abbreviations: BMI = body mass index; I^2 = index of heterogeneity; NA = not applicable; RR = relative risk.

Table 14. Meta-Analysis of Trials: Mean Gestational Weight Gain Stratified Analysis

Stratified Analysis	Category	Number of Trials	Mean Difference (kg) (95% Confidence Interval)	I^2	p for Subgroup Interaction
Study Population	Overall	55	-1.02 (-1.30 to -0.75)	60.3%	NA
BMI Category	Normal only	8	-0.48 (-0.96 to -0.21)	0.0%	0.06
	Overweight only	10	-0.89 (-1.54 to -0.32)	15.5%	
	Obese only	18	-1.63 (-2.45 to -0.91)	63.0%	
	Overweight-obese combined	20	-0.90 (-1.38 to -0.46)	31.1%	
	Mixed	28	-0.81 (-1.16 to -0.46)	60.7%	
Intervention Intensity	Low	9	-0.64 (-1.44 to 0.02)	48.4%	<0.001
	Moderate	18	-0.32 (-0.71 to -0.04)	17.6%	
	High	28	-1.47 (-1.78 to -1.22)	13.0%	
Intervention Type	Active	19	-1.29 (-1.60 to -1.04)	2.2%	0.07
	Counseling only	36	-0.86 (-1.27 to -0.50)	66.0%	
Weight Assessment Timepoint	28 weeks	1	-0.80 (-1.62 to 0.03)	NA	0.26
	34-36 weeks	13	-1.16 (-2.13 to -0.29)	66.9%	
	36 weeks to delivery	27	-0.89 (-1.24 to -0.58)	59.9%	
	Delivery	12	-1.22 (-1.83 to -0.69)	17.5%	
	2 weeks postpartum	1	-3.40 (-5.03 to -1.77)	NA	
	NR	1	0.09 (-0.79 to 0.97)	NA	
Intervention Quality	Fair	41	-1.11 (-1.42 to -0.81)	45.7%	0.30
	Good	14	-0.82 (-1.42 to -0.31)	73.3%	

Note: Overall, excluding Wolff (2008): 54 trials; -0.99 kg, 95% CI, -1.26 to -0.73, I^2=58.8%, p<0.001.
Abbreviations: BMI = body mass index; I^2 = index of heterogeneity; kg = kilogram; NA = not applicable.

Table 15. Meta-Analysis of Trials: Exceeding IOM Recommendations for Gestational Weight Gain Stratified Analysis

Stratified Analysis	Category	Number of Trials	RR (95% Confidence Interval)	I^2	p for Subgroup Interaction
Study Population	Overall	39	0.84 (0.78 to 0.90)	63.2%	NA
BMI Category	Normal only	9	0.74 (0.56 to 0.88)	38.7%	0.50
	Overweight only	6	0.91 (0.78 to 1.00)	0%	
	Obese only	9	0.83 (0.69 to 0.99)	56%	
	Overweight-obese combined	14	0.85 (0.78 to 0.94)	8.9%	
Intervention Intensity	Low	8	0.92 (0.74 to 1.11)	68.4%	<0.001
	Moderate	9	0.97 (0.92 to 1.03)	0%	
	High	22	0.74 (0.69 to 0.79)	0%	
Intervention Type	Active	15	0.73 (0.67 to 0.80)	0%	<0.001
	Counseling only	24	0.90 (0.82 to 0.98)	66.8%	

Note: Mixed BMI category removed from analysis, as participants would be double-counted in other categories.
Abbreviations: BMI = body mass index; I^2 = index of heterogeneity; IOM = Institute of Medicine; NA = not applicable; RR = relative risk.

Table 16. Meta-Analysis of Trials: Adherence to IOM Recommendations for Gestational Weight Gain Stratified Analysis

Stratified Analysis	Category	Number of Trials	RR (95% Confidence Interval)	I^2	p for Subgroup Interaction
Study Population	Overall	19	1.10 (0.89 to 1.35)	84.3%	NA
BMI Category	Normal only	1	1.15 (0.94 to 1.41)	NA	0.09
	Overweight only	0	NA	NA	
	Obese only	3	1.27 (1.05 to 1.80)	0%	
	Overweight-obese combined	4	1.27 (0.94 to 1.84)	39%	
	Mixed	11	0.95 (0.68 to 1.31)	88%	
Intervention Intensity	Low	7	1.09 (0.94 to 1.32)	0%	1.00
	Moderate	5	1.17 (1.02 to 1.34)	0%	
	High	7	1.01 (0.52 to 2.00)	94%	
Intervention Type	Active	5	0.98 (0.46 to 2.09)	95.4%	1.00
	Counseling only	14	1.12 (1.02 to 1.25)	0%	

Abbreviations: BMI = body mass index; I^2 = index of heterogeneity; IOM = Institute of Medicine; NA = not applicable; RR = relative risk.

Table 17. Meta-Analysis of Trials: Postpartum Weight Retention Stratified Analysis

Study Population (Followup Assessment)	Number of Trials	Mean Difference (kg) (95% Confidence Interval)	I^2	p for Subgroup Interaction
Less than 6 months	9	-0.81 (-2.40 to 0.55)	84.4%	NA
Normal only	1	-1.80 (-4.30 to 0.70)	NA	0.41
Overweight only	1	-1.85 (-3.65 to -0.05)	NA	
Obese only	3	-2.30 (-7.35 to 2.49)	88.5%	
Overweight-obese combined	3	0.32 (-1.97 to 3.34)	83.3%	
Mixed	4	-0.35 (-1.06 to 0.35)	0.0%	
6 months	3	-0.85 (-3.67 to 0.81)	70.6%	NA
Normal only	1	-1.20 (-2.39 to -0.01)	NA	NA
Overweight only	0	-	-	
Obese only	1	0.10 (-1.12 to 1.32)	NA	
Overweight-obese combined	2	-1.88 (-6.27 to 1.79)	74.1%	
Mixed	1	-0.91 (-1.97 to 0.15)	NA	
12 months	10	-0.63 (-1.44 to -0.01)	65.5%	NA
Normal only	0	-	-	0.75
Overweight only	0	-	-	
Obese only	2	-0.12 (-2.35 to 1.98)	0.0%	
Overweight-obese combined	3	-1.38 (-4.26 to 0.88)	82.2%	
Mixed	5	-0.69 (-1.39 to 0.11)	40.5%	

Note: Less than 6 months, excluding Wolff (2008): 8 trials; MD -0.17 kg, 95% CI, -0.97 to 0.53, I^2=69.5%.
Abbreviations: BMI = body mass index; I^2 = index of heterogeneity; NA = not applicable.

Table 18. Meta-Analysis of Trials: Small for Gestational Age Stratified Analysis

Stratified Analysis	Category	Number of Trials	RR (95% Confidence Interval)	I^2	p for Subgroup Interaction
Study Population	Overall	20	0.94 (0.80 to 1.10)	0%	NA
BMI Category	Normal only	1	0.83 (0.48 to 1.45)	NA	0.91
	Overweight only	0	NA	NA	
	Obese only	5	1.06 (0.55 to 1.96)	0%	
	Overweight-obese combined	7	1.01 (0.74 to 1.42)	0%	
	Mixed	7	0.87 (0.47 to 1.42)	43.6%	
Intervention Intensity	Low	2	0.39 (0.07 to 3.02)	42%	0.04
	Moderate	7	0.97 (0.79 to 1.25)	0%	
	High	11	0.99 (0.76 to 1.29)	0%	
Intervention Type	Active	4	1.00 (0.42 to 1.58)	0%	0.77
	Counseling only	16	0.93 (0.78 to 1.12)	0%	

Note: SGA defined as birthweight below the 10th percentile for gestational age; analyses do not include infants with low birth weight (less than 2,500 g, k=12).
Abbreviations: BMI = body mass index; I^2 = index of heterogeneity; NA = not applicable; RR = relative risk.

Table 16. Summary of Evidence

Outcome Category	Outcome	Studies (k); observations (n); study Designs	Summary of Findings	Consistency and Precision	Other Limitations	Strength of Evidence	Applicability
Maternal Health Outcomes	Gestational diabetes mellitus	43 RCTs, 2 CCTs (N=20,758)	Reduced rates of GDM (43 trials, RR, 0.87 [95% CI, 0.79 to 0.95]; I^2=16.4%; ARD -1.6% [95% CI, -2.5 to -0.7]). No effect when stratified by prepregnancy BMI subgroups (p=0.14 for interaction), intervention type (p=0.68), or intensity (p=0.92).	Consistent; reasonably precise	Variation in diagnostic criteria for GDM; differences in study groups by maternal BMI.	Moderate	Moderate
	Gestational hypertension	28 RCTs, 1 CCT (N=16,489)	No effect on rates of gestational hypertension (28 trials; RR, 0.87 [95% CI, 0.70 to 1.04]; I^2=32.5%; ARD, -0.8% [95% CI, -1.9 to 0.2]). Statistically significant effects when stratified by intervention type (p<0.001 for interaction) and intensity (p=0.006), but not BMI subgroup (p=0.08).	Consistent; reasonably precise	Variation in timing of outcome assessment and followup; interventions heterogeneous and varied in intensity; variations in prepregnancy weight and other demographic characteristics.	Moderate	Moderate

Table 16. Summary of Evidence

Outcome Category	Outcome	Studies (k); observations (n); study Designs	Summary of Findings	Consistency and Precision	Other Limitations	Strength of Evidence	Applicability
Maternal Health Outcomes	Cesarean delivery	46 RCTs, 2 CCTs (N=19,970)	No effect on rates of cesarean delivery (any type, 34 trials; RR, 0.98 [95% CI, 0.91 to 1.04]; I^2=10.8%; ARD, -0.7% [95% CI, -2.4 to 0.8]); increased risk of emergency cesarean (13 trials; RR, 0.87 [95% CI, 0.75 to 0.98]; I^2=0%; ARD, -2.2% [95% CI, -4.0 to 0.0]). No effect when cesarean delivery (any type) stratified by BMI subgroup (p=0.70 for interaction), intervention type (p=0.37), or intensity (p=0.37).	Consistent; reasonably precise	Indication for cesarean delivery not reported in any study; unclear indications for cesarean among the studies reporting statistical differences between groups, including lack of reporting of parameters to determine elective or emergency cesarean.	Moderate	Moderate
	Preeclampsia	27 RCTs, 1 CCT (N=17,002)	No association between interventions and rates of preeclampsia (27 trials; RR, 0.98 [95% CI, 0.84 to 1.13]; I^2=0.0%; ARD, 0.1% [95% CI, -0.6 to 0.5]). No effect when stratified by BMI subgroup (p=0.86 for interaction), intervention type (p=0.25), or intensity (p=0.29).	Consistent; precise	Differences in followup duration and outcome assessment timing; low event rates; heterogeneous interventions; populations varied in prepregnancy weight and demographic characteristics.	High	Moderate

Table 16. Summary of Evidence

Outcome Category	Outcome	Studies (k); observations (n); study Designs	Summary of Findings	Consistency and Precision	Other Limitations	Strength of Evidence	Applicability
Maternal Health Outcomes	Postpartum hemorrhage	9 RCTs, 1 CCT (N=6,488)	No effect was on rates of postpartum hemorrhage (9 trials; RR, 1.00 [95% CI, 0.88 to 1.15]; I^2=0%; ARD, -0.1% [95% CI, -1.3 to 1.5]). No effect when stratified by BMI subgroup (p=0.65 for interaction), intervention type (p=1.00), or intensity (p=0.99).	Consistent; precise	Variation in outcome definition; majority of studies not powered to detect statistical differences in outcomes; low event rates.	Low	Low
	Perineal trauma	8 RCTs (N=5,781)	No effect on rates of perineal trauma (8 trials; RR, 0.86 [95% CI, 0.52 to 1.50]; I^2=57%; ARD, -0.7%, [95% CI, -3.2 to 1.7]). Statistically significant effects when stratified by BMI subgroup (p=0.003 for interaction) and intervention intensity (p=0.003), but not type (p=0.73).	Consistent; imprecise	Variation in outcome definition; majority of studies not powered to detect statistical differences in outcomes; low event rates.	Low	Moderate
	Maternal mortality	2 RCTs (N=2,994)	No effect on rates of maternal death in 2 trials. No deaths were reported to be related to the interventions.	Consistent; imprecise	Low event rates; studies not designed or powered to detect statistical differences in outcomes; rare events unrelated to intervention.	Low	Low
Prepregnancy Weight Reduction Outcomes	Weight outcomes	1 RCT (N=326)	No effect on rates of excess gestational weight gain; increased GWG for intervention vs. controls (13.2 kg [SD, 8.2] vs. 10.3 kg [SD, 7.4], p=0.03).	N/A	Only one study included; large confidence intervals in some analyses.	Insufficient	Low

Table 16. Summary of Evidence

Outcome Category	Outcome	Studies (k); observations (n); study Designs	Summary of Findings	Consistency and Precision	Other Limitations	Strength of Evidence	Applicability
Infant Health Outcomes	Macrosomia	26 RCTs, 1 CCT (N=14,213)	Reduction in rates of macrosomia (25 trials; RR, 0.77, [95% CI, 0.65 to 0.92]; I^2=38.3%; ARD, -1.9% [95% CI, -3.3 to -0.7]). Statistically significant effects when stratified by intervention intensity (p=0.03 for interaction) but not BMI subgroup (p=0.24) or intervention type (p=1.00).	Consistent; imprecise	Varied definitions for outcome (less than 4,000 g and more than 4,500 g); low event rates.	Moderate	Moderate
	Large for gestational age	27 RCTs (N=13,070)	Reduced rates of LGA (26 trials; RR, 0.89 [95% CI, 0.80 to 0.99]; I^2=0%; ARD, -1.3% [95% CI, -2.3 to -0.3]). No effect when stratified by BMI subgroup (p=0.98 for interaction), intervention type (p=0.18), or intensity (p=0.22).	Consistent; precise	Studies not powered to address LGA; low event rates.	Moderate	Moderate
	Preterm birth	34 RCTs, 1 CCT (N=17,166)	No effect on rates of preterm birth (33 trials; RR, 0.93 [95% CI, 0.81 to 1.07]; I^2=2.2%; ARD, -0.2% [95% CI, -1.1 to 0.7]). No effect when stratified by BMI subgroup (p=0.10 for interaction), intervention type (p=0.56), or intensity (p=0.42).	Consistent; precise	Studies not powered to address preterm birth; varied definitions used for preterm birth (less than 36 weeks, 37 weeks, or not reported); low event rates.	Moderate	Moderate

Table 16. Summary of Evidence

Outcome Category	Outcome	Studies (k); observations (n); study Designs	Summary of Findings	Consistency and Precision	Other Limitations	Strength of Evidence	Applicability
Infant Health Outcomes	Respiratory distress syndrome	8 RCTs (N=3,155)	No effect on rates of RDS (8 trials; RR, 1.00 [95% CI, 0.67 to 1.42]; I^2=0%; ARD -0.3% [95% CI, -1.3 to 0.7]). No effect when stratified by BMI subgroup (p=0.19 for interaction), intervention type (p=0.25), or intensity (p=0.42).	Consistent; precise	Studies not powered to address RDS; low event rates.	Low	Low
	Shoulder dystocia	8 RCTs (N=6,461)	No effect on rates of shoulder dystocia (8 trials; RR, 1. [95% CI, 0.63 to 1.47]; I^2=0%; ARD, 0.0%, [95% CI, -0.4 to 0.5]). No effect when stratified by BMI subgroup (p=0.55 for interaction), intervention type (p=0.61), or intensity (p=0.89).	Consistent; precise	Studies not powered to address shoulder dystocia; low event rates.	Low	Low
	NICU admissions	15 RCTs (N=8,523)	No effect of rates of NICU admission (14 trials; RR, 0.98 [95% CI, 0.86 to 1.08]; I^2=0%; ARD, -0.7%, [95% CI, -1.9 to 0.5]). No effect when stratified by BMI subgroup (p=0.38 for interaction), intervention type (p=0.47), or intensity (p=0.82).	Consistent; precise	Studies not powered to address NICU admission; low event rates.	Low	Low

Table 16. Summary of Evidence

Outcome Category	Outcome	Studies (k); observations (n); study Designs	Summary of Findings	Consistency and Precision	Other Limitations	Strength of Evidence	Applicability
Infant Health Outcomes	Infant mortality / stillbirth	11 RCTs (N=7,090)	No effect reported for neonatal death or stillbirth. No deaths were reported to be related to the interventions.	Consistent; imprecise	Studies not powered to address infant mortality/ stillbirth; low event rates.	Low	Low
	Growth during first year of life	3 RCTs (N=2,516)	No differences between interventions during pregnancy versus usual care on infant growth during the first year of life	Consistent; imprecise	Studies not powered to address growth during first year of life.	Low	Low
Gestational Weight Outcomes	Mean gestational weight gain	63 RCTs, 4 CCTs (N=25,463)	Greater reductions in overall gestational weight gain for interventions versus controls (55 trials; MD, -1.02 kg [95% CI, -1.30 to -0.75]; I^2=60.3%). Statistically significant effect when stratified by intervention intensity (p<0.001 for interaction), but not BMI subgroup (p=0.06), intervention type (p=0.07), weight assessment timepoint (p=0.26), or intervention quality (p=0.30).	Reasonably consistent direction within BMI categories but inconsistent magnitude of effect; imprecise	Variation in timing of outcome assessment (e.g., from one month prior to delivery to delivery); type of GWG not defined (e.g., fat vs. fluid retention); variation in prepregnancy weight categories enrolled; few studies report on enrollment or outcomes related to subgroups of importance (e.g., SES or racial and ethnic minorities); heterogeneous interventions, components not always well-described; differences in timing of initiation and/or duration of intervention.	Moderate	Moderate

Table 16. Summary of Evidence

Outcome Category	Outcome	Studies (k); observations (n); study Designs	Summary of Findings	Consistency and Precision	Other Limitations	Strength of Evidence	Applicability
Gestational Weight Outcomes	Exceeding IOM recommendations for GWG	41 RCTs, 1 CCT (N=14,895)	Lower likelihood of gaining weight in excess of IOM recommendations (39 trials; RR, 0.84 [95% CI, 0.78 to 0.90]; I^2=63.2%; ARD, -7.7% [95% CI, -11.0 to -4.6]). Statistically significant effect for excess GWG and intervention type (p<0.001 for interaction) and intensity (p<0.001), but not BMI (p=0.50).	Consistent; imprecise	Same as above	Moderate	Moderate
	Adherence to IOM recommendations for GWG	19 RCTs (N=5,839)	No effect on rates of adherence to IOM recommendations for GWG (19 trials; RR, 1.10, [95% CI, 0.89 to 1.35]; I^2=84.3%; ARD, 4.2% [95% CI, -1.2 to 10]). No effect when stratified by BMI subgroup (p=0.09 for interaction), intervention type (p=1.00), or intensity (p=1.00).	Relatively consistent; imprecise	Same as above	Low	Moderate

Table 16. Summary of Evidence

Outcome Category	Outcome	Studies (k); observations (n); study Designs	Summary of Findings	Consistency and Precision	Other Limitations	Strength of Evidence	Applicability
Gestational Weight Outcomes	Postpartum weight retention	13 RCTs, 1 CCT (N=5,060)	Greater reductions in postpartum weight retention at followup time of 12 months (MD, -0.63 kg [95% CI, -1.44 to -0.01]; I^2=65.5%), but not followup times of less than 6 months (MD, -0.81 kg [95% CI, -2.40 to 0.55]; I^2=84.4%) or 6 months (MD, -0.85 kg [95% CI, -3.67 to 0.81]; I^2=70.6%). No effect when stratified by BMI subgroup at less than 6 months (p=0.41 for interaction) or 12 months (p=0.75).	Reasonably consistent; imprecise	Differences in followup time; differing duration of interventions; limited or no reporting of known factors associated with postpartum weight retention (e.g. breastfeeding); substantial heterogeneity of pooled estimates.	Low	Moderate
Harms	Depression and anxiety	10 RCTs, 2 CCT (N=3,116)	Mixed effects reported for rates of depression and anxiety as measured by various, validated symptom scales.	Inconsistent, imprecise	Not reported as harms of intervention; measured as changes in symptoms; heterogeneous intervention components, duration, intensity, and followup, and few studies overall.	Low	Moderate

Table 16. Summary of Evidence

Outcome Category	Outcome	Studies (k); observations (n); study Designs	Summary of Findings	Consistency and Precision	Other Limitations	Strength of Evidence	Applicability
Harms	Small for gestational age	29 RCTs, 1 CCT (N=14,168)	No difference in rates of SGA (20 trials; RR, 0.94 [95% CI, 0.80 to 1.10]; I^2=0.0%; ARD, -0.4% [95% CI, -1.7 to 1.0]). No differences between interventions during pregnancy versus usual care on low birth weight in 12 trials. Statistically significant effect when stratified by intervention intensity (p=0.04 for interaction), but not BMI subgroup (p=0.91) or intervention type (p=0.77).	Consistent; reasonably precise	Studies not powered to address SGA; varied definitions used for SGA (less than 10% for gestational age) or low birth weight (less than 2,500 g); low event rates.	Moderate	Moderate

Abbreviations: ARD = absolute risk difference; BMI = body mass index; CCT = controlled clinical trials; CI = confidence interval; GDM = gestational diabetes mellitus; GWG = gestational weight gain; I^2 = statistic for heterogeneity; IOM = Institute of Medicine; LGA = large for gestational age; MD = mean difference; N = number; NA = not applicable; NICU = neonatal intensive care unit; RCT = randomized controlled trials; RDS = respiratory distress syndrome; RR = relative risk; SGA = small for gestational age.

Appendix A1. Search Strategies

Ovid MEDLINE® Database Searches
Search Strategy:
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1 Pregnant Women/
2 exp Pregnancy/
3 perinatal care/ or prenatal care/
4 (pregnan* or maternal or gestation* or perinatal or prenatal or antenatal or postpartum).ti,ab.
5 or/1-4
6 PRECONCEPTION CARE/
7 (prepregnan* or preconception* or "pre-pregnan*" or "pre-conception").ti,ab.
8 6 or 7
9 Pregnancy Outcome/
10 exp Pregnancy Complications/
11 9 or 10
12 5 or 8 or 11
13 body weight/ or exp body weight changes/ or exp overweight/
14 body mass index/
15 (weight or overweight or obes* or BMI).ti,ab.
16 12 and (13 or 14 or 15)
17 exp Life Style/
18 exp Diet Therapy/
19 exp Exercise/
20 exp Physical Fitness/
21 counseling/ or exp directive counseling/
22 exp Behavior Therapy/
23 exp Motivation/
24 health behavior/ or risk reduction behavior/
25 exp Patient Education as Topic/
26 exp social support/
27 health education/ or exp health promotion/
28 (diet or exercise or lifestyle or "life style" or advice or advise or behavior* or behaviour* or nonpharma* or "non-pharma*").ti,ab.
29 or/17-28
30 16 and 29
31 limit 30 to (english language and humans)
32 limit 31 to (clinical trial, all or comparative study or controlled clinical trial or randomized controlled trial)
33 31 and (random* or control* or cohort or trial).ti,ab,kw.
34 32 or 33

Ovid MEDLINE® In-Process & Other Non-Indexed Citations
Search Strategy:
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1 (pregnan* or maternal or gestation* or perinatal or prenatal or antenatal or postpartum).ti,ab.
2 (prepregnan* or preconception* or "pre-pregnan*" or "pre-conception").ti,ab.
3 (weight or overweight or obes* or BMI).ti,ab.

4 (diet or exercise or lifestyle or "life style" or counsel* or advice or advise or behavior* or behaviour* or nonpharma* or "non-pharma*").ti,ab.
5 (1 or 2) and 3 and 4
6 5 and (random* or control* or trial or cohort).ti,ab,kw.

EBM Reviews - Cochrane Central Register of Controlled Trials
Search Strategy:
---
1 Pregnant Women/
2 exp Pregnancy/
3 perinatal care/ or prenatal care/
4 (pregnan* or maternal or gestation* or perinatal or prenatal or antenatal or postpartum).ti,ab.
5 or/1-4
6 PRECONCEPTION CARE/
7 (prepregnan* or preconception* or "pre-pregnan*" or "pre-conception").ti,ab.
8 6 or 7
9 Pregnancy Outcome/
10 exp Pregnancy Complications/
11 9 or 10
12 5 or 8 or 11
13 body weight/ or exp body weight changes/ or exp overweight/
14 body mass index/
15 (weight or overweight or obes* or BMI).ti,ab.
16 12 and (13 or 14 or 15)
17 exp Life Style/
18 exp Diet Therapy/
19 exp Exercise/
20 exp Physical Fitness/
21 counseling/ or exp directive counseling/
22 exp Behavior Therapy/
23 exp Motivation/
24 health behavior/ or risk reduction behavior/
25 exp Patient Education as Topic/
26 exp social support/
27 health education/ or exp health promotion/
28 (diet or exercise or lifestyle or "life style" or advice or advise or behavior* or behaviour* or nonpharma* or "non-pharma*").ti,ab.
29 or/17-28
30 16 and 29
31 limit 30 to english language

EBM Reviews - Cochrane Database of Systematic Reviews
Search Strategy:
---
1 pregnan*,ti,ab.mp. [mp=title, short title, abstract, full text, keywords, caption text]
2 (pregnant or pregnancy or gestation*).ti,ab.

3 2 and (weight or Overweight and obese or obesity).ti,ab.
4 3 and (diet or exercise or counsel* or advise or advise or behavior* of behaviour* or nonpharm* or "non-pharma*").ti,ab.

PsycINFO
Search Strategy:
---
1 exp Pregnancy/
2 perinatal care/ or prenatal care/
3 (pregnan* or maternal or gestation* or perinatal or prenatal or antenatal or postpartum).ti,ab.
4 (prepregnan* or preconception* or "pre-pregnan*" or "pre-conception").ti,ab.
5 Pregnancy Outcome/
6 body weight/ or exp body weight changes/ or exp overweight/
7 body mass index/
8 (weight or overweight or obes* or BMI).ti,ab.
9 exp Exercise/
10 exp Physical Fitness/
11 counseling/ or exp directive counseling/
12 exp Behavior Therapy/
13 exp Motivation/
14 health behavior/ or risk reduction behavior/
15 exp social support/
16 health education/ or exp health promotion/
17 (diet or exercise or lifestyle or "life style" or counsel* or advice or advise or behavior* or behaviour* or nonpharma* or "non-pharma*").ti,ab.
18 (or/1-5) and (or/6-8)
19 18 and (or/9-17)
20 19 and (random* or control* or trial or cohort).ti,ab.

Appendix A2. Included and Excluded Criteria

	Included	Excluded
Population	• Pregnant women with normal or high BMI • Women who are Overweight and obese (defined by BMI) and planning pregnancy, including adolescents and adults	• Studies limited to pregnant women with gestational diabetes mellitus • Women with preexisting diabetes
Intervention	• Primary care–relevant interventions that aim to limit excess gestational weight gain or reduce prepregnancy weight, and focus on one or more of the following: diet, exercise, behavioral counseling • Conducted in or recruited from primary care or health care system, or could feasibly be implemented in or referred from primary care	• Pharmacologic interventions • Broader community-based programs (e.g., mass media, changes to community-built environment)
Outcome	**KQ1 – health outcomes:** • Maternal or infant mortality (incl. stillbirth) • Maternal morbidity (e.g., postpartum hemorrhage, perineal trauma, depression) • Infant morbidity (e.g., birth trauma, shoulder dystocia, respiratory distress syndrome) **KQ2 – weight outcomes:** • Preconception weight loss (kg or BMI) • Excessive gestational weight gain (per IOM recommendation or as described by authors) • Measured gestational weight gain (kg or BMI) • Maternal postpartum weight loss or retention • Incidence or prevalence of maternal obesity-related perinatal conditions (e.g., macrosomia, preterm birth, gestational diabetes mellitus, hypertension, cesarean delivery) **KQ3 – harms** • Harms associated with interventions (e.g., anxiety, stigma, maternal musculoskeletal injuries) • Harms related to insufficient weight gain (e.g., 'small for gestational age' infants)	**KQ1** • Behavioral changes (e.g., physical activity level) **KQ2** • Cardiometabolic measures (e.g., glucose level, blood pressure, lipid level)

Comparator	• Interventions with a comparator or control group; for example:
	  o No treatment (wait-list, usual care)
	  o Attention control
	  o Minimal intervention
		Interventions without a control / comparator group

Study Design	**KQ1-KQ3** • Controlled clinical trial **KQ3** • Cohort or case-control studies reporting harms related to interventions to reduce gestational weight gain and prepregnancy weight	All other study designs
Study Quality	Fair- or good-quality studies	Poor-quality studies
Country	Countries considered 'very high' on the 2016 Human Development Index	Countries not rated 'very high'

Appendix A2. Included and Excluded Criteria

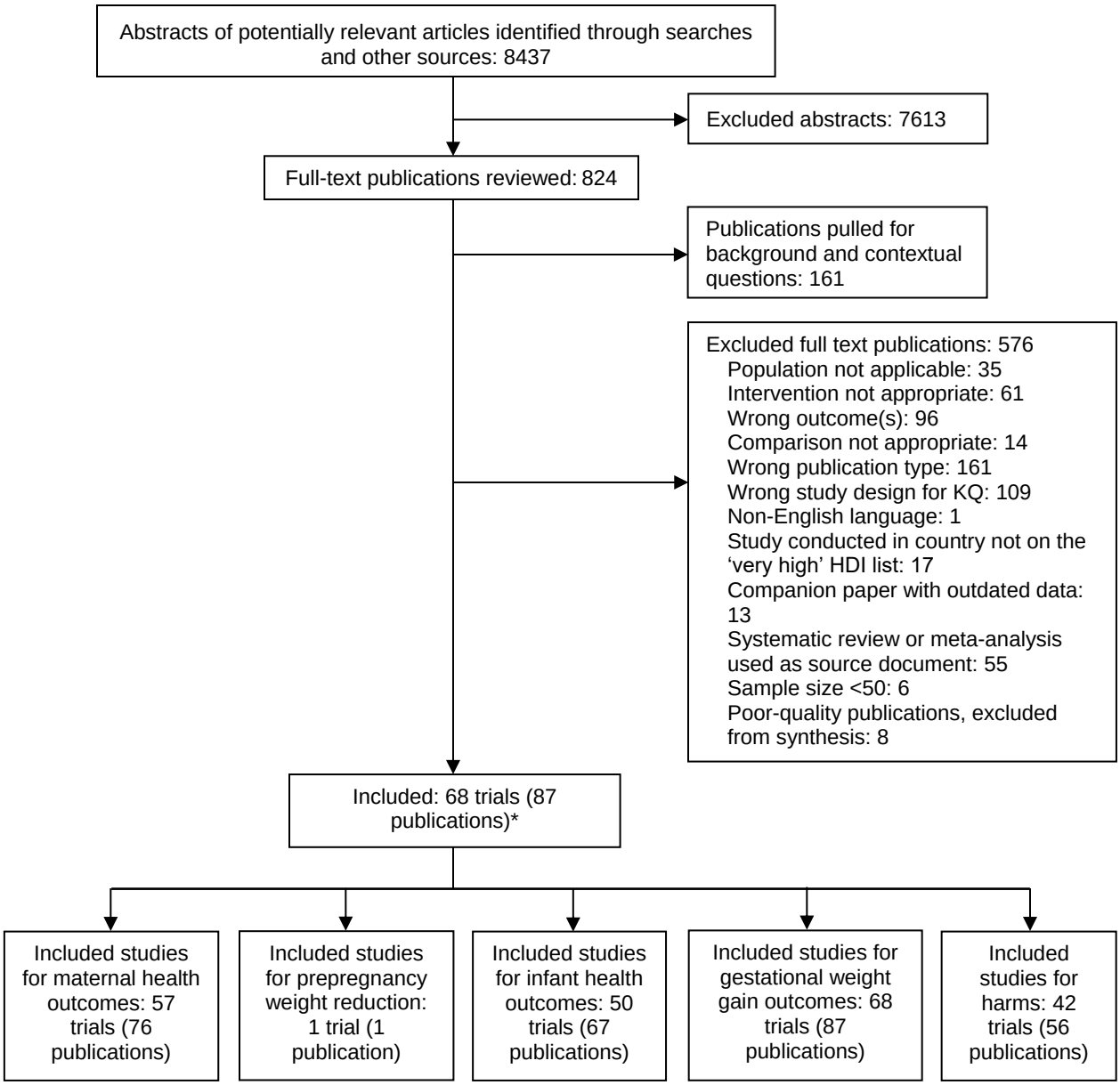
Notes on Included/Excluded criteria

Mode of delivery: Interventions may be delivered via face-to-face contact, telephone, print materials, or technology (e.g., computer-based, text messages) and can be delivered by numerous potential providers (e.g., clinicians, nurses, exercise specialists, dietitians, nutritionists, behavioral health specialists, etc.)

Countries rated 'very high' on the 2016 HDI

Australia	Denmark	Japan	Poland	U.K.
Andorra	Estonia	South Korea	Portugal	U.S.
Argentina	Finland	Kuwait	Qatar	U.A.E.
Austria	France	Latvia	Romania	
Bahrain	Germany	Liechtenstein	Russia	
Belgium	Greece	Lithuania	Saudi Arabia	
Brunei	Hong Kong	Luxembourg	Singapore	
Canada	Hungary	Malta	Slovakia	
Chile	Iceland	Montenegro	Slovenia	
Croatia	Ireland	Netherlands	Spain	
Cyprus	Israel	New Zealand	Sweden	
Czech Republic	Italy	Norway	Switzerland	

Appendix A3. Literature Flow Diagram



*Some included publications are counted in multiple sections.
Note: Targeted searches for the contextual questions are not included in the current diagram.

Appendix A4. List of Included Studies

1. Aguilar-Cordero MJ, Sanchez-Garcia JC, Rodriguez-Blanque R, et al. Moderate physical activity in an aquatic environment during pregnancy (SWEP Study) and its influence in preventing postpartum depression. J Am Psychiatr Nurses Assoc. 2019 Apr;25(2):112-21. doi: 10.1177/1078390317753675. PMID: 29490560.
2. Al Wattar BH, Dodds J, Placzek A, et al. Mediterranean-style diet in pregnant women with metabolic risk factors (ESTEEM): a pragmatic multicentre randomised trial. PLOS Medicine. 2019 Jul 23;16(7):e1002857. doi: 10.1371/journal.pmed.1002857. PMID: 31335871
3. Altazan AD, Redman LM, Burton JH, et al. Mood and quality of life changes in pregnancy and postpartum and the effect of a behavioral intervention targeting excess gestational weight gain in women with overweight and obesity: a parallel-arm randomized controlled pilot trial. BMC Pregnancy Childbirth. 2019 Jan 29;19(1):50. doi: 10.1186/s12884-019-2196-8. PMID: 30696408.
4. Althuizen E, van der Wijden CL, van Mechelen W, et al. The effect of a counselling intervention on weight changes during and after pregnancy: a randomised trial. BJOG. 2013 Jan;120(1):92-9. doi: 10.1111/1471-0528.12014. PMID: 23121074.
5. Asbee SM, Jenkins TR, Butler JR, et al. Preventing excessive weight gain during pregnancy through dietary and lifestyle counseling: a randomized controlled trial. Obstet Gynecol. 2009 Feb;113(2 Pt 1):305-12. doi: 10.1097/AOG.0b013e318195baef. PMID: 19155899.
6. Assaf-Balut C, Garcia de la Torre N, Duran A, et al. A Mediterranean diet with additional extra virgin olive oil and pistachios reduces the incidence of gestational diabetes mellitus (GDM): a randomized controlled trial: the St. Carlos GDM prevention study. PLoS ONE. 2017 Oct 19;12(10):e0185873. doi: 10.1371/journal.pone.0185873. PMID: 29049303.
7. Bacchi M, Mottola MF, Perales M, et al. Aquatic activities during pregnancy prevent excessive maternal weight gain and preserve birth weight: a randomized clinical trial. Am J Health Promot. 2018 Mar;32(3):729-35. doi: 10.1177/0890117117697520. PMID: 28279085.
8. Barakat R, Cordero Y, Coteron J, et al. Exercise during pregnancy improves maternal glucose screen at 24-28 weeks: a randomised controlled trial. Br J Sports Med. 2012 Jul;46(9):656-61. doi: 10.1136/bjsports-2011-090009. PMID: 21948120.
9. Barakat R, Franco E, Perales M, et al. Exercise during pregnancy is associated with a shorter duration of labor. A randomized clinical trial. Eur J Obstet Gynecol Reprod Biol. 2018 May;224:33-40. doi: 10.1016/j.ejogrb.2018.03.009. PMID: 29529475.
10. Barakat R, Pelaez M, Cordero Y, et al. Exercise during pregnancy protects against hypertension and macrosomia: randomized clinical trial. Am J Obstet Gynecol. 2016 May;214(5):649.e1-8. doi: 10.1016/j.ajog.2015.11.039. PMID: 26704894.
11. Barakat R, Perales M, Bacchi M, et al. A program of exercise throughout pregnancy. Is it safe to mother and newborn? Am J Health Promot. 2014 Sep-Oct;29(1):2-8. doi: 10.4278/ajhp.130131-QUAN-56. PMID: 24200335.
12. Barakat R, Refoyo I, Coteron J, et al. Exercise during pregnancy has a preventative effect on excessive maternal weight gain and gestational diabetes. A randomized controlled trial. Braz J Phys Ther. 2019 Apr;23(2):148-55. doi: 10.1016/j.bjpt.2018.11.005. PMID: 30470666.
13. Bogaerts AF, Devlieger R, Nuyts E, et al. Effects of lifestyle intervention in obese pregnant women on gestational weight gain and mental health: a randomized controlled trial. Int J Obes (Lond). 2013 Jun;37(6):814-21. doi: 10.1038/ijo.2012.162. PMID: 23032404.

14. Brownfoot FC, Davey MA, Kornman L. Routine weighing to reduce excessive antenatal weight gain: a randomised controlled trial. BJOG. 2016 Dec;123(2):254-61. doi: 10.1111/1471-0528.13735. PMID: 26840637.
15. Bruno R, Petrella E, Bertarini V, et al. Adherence to a lifestyle programme in overweight/obese pregnant women and effect on gestational diabetes mellitus: a randomized controlled trial. Matern Child Nutr. 2017 Jul;13(3) doi: 10.1111/mcn.12333. PMID: 27647837.
16. Cahill AG, Haire-Joshu D, Cade WT, et al. Weight control program and gestational weight gain in disadvantaged women with overweight or obesity: a randomized clinical trial. Obesity (Silver Spring). 2018 Mar;26(3):485-91. doi: 10.1002/oby.22070. PMID: 29464907.
17. Claesson IM, Josefsson A, Sydsjo G. Prevalence of anxiety and depressive symptoms among obese pregnant and postpartum women: an intervention study. BMC Public Health. 2010 Dec 16;10:766. doi: 10.1186/1471-2458-10-766. PMID: 21162715.
18. Daley A, Jolly K, Jebb S, et al. Feasibility and acceptability of regular weighing, setting weight gain limits and providing feedback by community midwives to prevent excess weight gain during pregnancy: randomised controlled trial and qualitative study. BMC Obesity. 2015 Sep 16;2(1):35. doi: 10.1186/s40608-015-0061-5. PMID: 26401345.
19. Daley A JKJSARAMLLACSUMOCKSMCAP. Effectiveness of a behavioural intervention involving regular weighing and feedback by community midwives within routine antenatal care to prevent excessive gestational weight gain: POPS2 randomised controlled trial. BMJ Open; 2019. p. e030174.
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Appendix A5. List of Excluded Studies

1. ACOG. Nutrition during pregnancy. ACOG Technical Bulletin Number 179--April 1993. Int J Gynaecol Obstet. 1993 Oct;43(1):67-74. doi: 10.1016/0020-7292(93)90281-Z. PMID: 7904962. **Exclusion: wrong publication type.**
2. Adam LM, Jarman M, Barker M, et al. Use of healthy conversation skills to promote healthy diets, physical activity and gestational weight gain: results from a pilot randomised controlled trial. Patient Educ Couns. 2020 Jul. doi: 10.1016/j.pec.2020.01.001. **Exclusion: wrong intervention.**
3. Adamo KB, Ferraro ZM, Brett KE. Can we modify the intrauterine environment to halt the intergenerational cycle of obesity? Int J Environ Res Public Health. 2012 Apr;9(4):1263-307. doi: 10.3390/ijerph9041263. PMID: 22690193. **Exclusion: wrong publication type.**
4. Adamo KB, Ferraro ZM, Goldfield G, et al. The Maternal Obesity Management (MOM) trial protocol: a lifestyle intervention during pregnancy to minimize downstream obesity. Contemp Clin Trials. 2013 May;35(1):87-96. doi: 10.1016/j.cct.2013.02.010. PMID: 23459089. **Exclusion: wrong publication type.**
5. Adane AA, Tooth LR, Mishra GD. Pre-pregnancy weight change and incidence of gestational diabetes mellitus: a finding from a prospective cohort study. Diabetes Res Clin Pract. 2017 Feb;124:72-80. doi: 10.1016/j.diabres.2016.12.014. PMID: 28110238. **Exclusion: wrong intervention.**
6. Adesegun D, Cai C, Sivak A, et al. Prenatal exercise and pre-gestational diseases: a systematic review and meta-analysis. J Obstet Gynaecol Can. 2018 Dec 28;41(8):1134-43. doi: 10.1016/j.jogc.2018.10.007. PMID: 30598427. **Exclusion: systematic review or meta-analysis used only as a source document for pearling.**
7. Agricola E, Pandolfi E, Gonfiantini MV, et al. A cohort study of a tailored web intervention for preconception care. BMC Med Inf Decis Mak. 2014 Apr 15;14(33) doi: 10.1186/1472-6947-14-33. PMID: 24731520. **Exclusion: wrong outcome.**
8. Aguilera M, Sidebottom AC, McCool BR. Examination of routine use of prenatal weight gain charts as a communication tool for providers. Matern Child Health J. 2017 Oct;21(10):1927-38. doi: 10.1007/s10995-017-2308-x. PMID: 28707103. **Exclusion: wrong outcome.**
9. Ainscough K, Kennelly M, Lindsay KL, et al. Impact of an mHealth supported healthy lifestyle intervention on behavioural stage of change in overweight and obese pregnancy. Proc Nutr Soc. 2016;Conference: summer meeting. 2016: new technology in nutrition research and practice. Ireland 75(OCE3):E85. **Exclusion: wrong publication type.**
10. Ainscough K, Kennelly M, O'Sullivan E, et al. Impact of an mHealth-supported behavioural lifestyle intervention on exercise stage-of-change and physical activity in overweight and obese pregnancy: pEARs randomised controlled trial (RCT). BJOG. Conference: 19th annual conference of the british maternal and fetal medicine society, BMFMS. 2017;124:96-7. **Exclusion: wrong publication type.**
11. Ainscough K, Kennelly MA, O'Sullivan EJ, et al. Impact of a smartphone app supporting a lifestyle intervention in overweight and obese pregnancy on on maternal health and lifestyle outcomes. Am J Obstet Gynecol. 2018;Conference: 38th annual meeting of the society for maternal-fetal medicine: the pregnancy meeting. United states. 218(1 Supplement 1):S598-S9. **Exclusion: wrong publication type.**
12. Ainscough KM, Kennelly MA, O'Sullivan EJ, et al. Impact of an mhealth-supported behavioral lifestyle intervention on behavioral stage of

change and physical activity in overweight and obese pregnancy: pears randomized controlled trial. Reprod Sci. 2017;Conference: 64th annual scientific meeting of the society for gynecologic investigation, SGI. 2017. United states 24(1 Supplement 1):186A. **Exclusion: wrong publication type.**

13. Ainscough KM, Lindsay KL, Gibney ER, et al. A review of the integration of behaviour change methodologies in randomised controlled trial lifestyle interventions among overweight and obese women during pregnancy. Obes Facts. 2016;9(207). **Exclusion: wrong publication type.**
14. Al Wattar BH. Mediterranean-style diet in pregnancies with metabolic risk factors (ESTEEM): a pragmatic multicente. Int J Gynaecol Obstet. 2018;143:192. doi: 10.1371/journal.pmed.1002857. PMID: 31335871. **Exclusion: wrong publication type.**
15. Al Wattar BH, Mylrea-Lowndes B, Moore A, et al. Dietary assessment methods in pregnancy: a systematic review of literature. BJOG. 2015;122(254). **Exclusion: wrong publication type.**
16. Al Wattar BH, Mylrea-Lowndes B, Morgan C, et al. Use of dietary assessment tools in randomized trials evaluating diet-based interventions in pregnancy: a systematic review of literature. Curr Opin Obstet Gynecol. 2016 Dec;28(6):455-63. doi: 10.1097/GCO.0000000000000322. PMID: 27755129. **Exclusion: systematic review or meta-analysis used only as a source document for pearling.**
17. Allen R, Rogozinska E, Sivarajasingam P, et al. Effect of diet- and lifestyle-based metabolic risk-modifying interventions on preeclampsia: a meta-analysis. Acta Obstet Gynecol Scand. 2014 Oct;93(10):973-85. doi: 10.1111/aogs.12467. PMID: 25138651. **Exclusion: systematic review or meta-analysis used only as a source document for pearling.**
18. Al-Ofi EA, Mosli HH, Ghamri KA, et al. Management of postprandial hyperglycaemia and weight gain in women with gestational diabetes mellitus using a novel telemonitoring system. J Int Med Res. 2019 Feb;47(2):754-64. doi: 10.1177/0300060518809872. PMID: 30442052. **Exclusion: wrong population.**
19. Anand SS, Gupta M, Teo KK, et al. Causes and consequences of gestational diabetes in South Asians living in Canada: results from a prospective cohort study. CMAJ Open. 2017 Aug 9;5(3):E604-E11. doi: 10.9778/cmajo.20170027. PMID: 28800568. **Exclusion: wrong intervention.**
20. Anderson LN, Knight JA, Hung RJ, et al. The Ontario Birth Study: a prospective pregnancy cohort study integrating perinatal research into clinical care. Paediatr Perinat Epidemiol. 2018 May;32(3):290-301. doi: 10.1111/ppe.12473. PMID: 29750375. **Exclusion: wrong intervention.**
21. Angel MD, De Haene J, Perez M, et al. Dietary patterns associated with gestational weight gain and fat mass gain in overweight and obese pregnant women. Faseb J. 2011;25(9). **Exclusion: wrong study design.**
22. Anleu E, Reyes M, Araya BM, et al. Effectiveness of an intervention of dietary counseling for overweight and obese pregnant women in the consumption of sugars and energy. Nutrients. 2019 Feb 13;11(2):13. doi: 10.3390/nu11020385. PMID: 30781781. **Exclusion: wrong outcome.**
23. AprOn, Teams ES. Adherence to Canada's food guide recommendations during pregnancy: nutritional epidemiology and public health. Curr Dev Nutr. 2017 Jul;1(7):e000356. doi: 10.3945/cdn.116.000356. PMID: 29955709. **Exclusion: wrong outcome.**

24. Arden MA, Duxbury AM, Soltani H. Responses to gestational weight management guidance: a thematic analysis of comments made by women in online parenting forums. BMC Pregnancy Childbirth. 2014 Jun 30;14(216) doi: 10.1186/1471-2393-14-216. PMID: 24981024. **Exclusion: wrong publication type.**
25. Arendas K, Qiu Q, Gruslin A. Obesity in pregnancy: pre-conceptional to postpartum consequences. J Obstet Gynaecol Can. 2008 Jun;30(6):477-88. doi: 10.1016/S1701-2163(16)32863-8. PMID: 18611299. **Exclusion: wrong publication type.**
26. Arianas EA, Rankin KM, Norr KF, et al. Maternal weight status and responsiveness to preterm infant behavioral cues during feeding. BMC Pregnancy Childbirth. 2017 Apr 11;17(113) doi: 10.1186/s12884-017-1298-4. PMID: 28399825. **Exclusion: wrong population.**
27. Arinze NV, Karp SM, Gesell SB. Evaluating provider advice and women's beliefs on total weight gain during pregnancy. J Immigr Minor Health. 2016 Feb;18(1):282-6. doi: 10.1007/s10903-015-0162-8. PMID: 25649967. **Exclusion: wrong intervention.**
28. Daily weight monitoring in pregnancy-a randomised controlled trial. Aust N Z J Obstet Gynaecol; 2016. 56. **Exclusion: wrong comparator.**
29. Asci O, Rathfisch G. Effect of lifestyle interventions of pregnant women on their dietary habits, lifestyle behaviors, and weight gain: a randomized controlled trial. J Health Popul Nutr. 2016 Feb 24;35(7) doi: 10.1186/s41043-016-0044-2. PMID: 26911204. **Exclusion: wrong country.**
30. Babbar S, Porter BW, Williams KB. The impact of prenatal yoga on exercise attitudes and behavior: teachable moments from a randomized controlled trial. In J Yoga Therap. 2017 Nov;27(1):37-48. doi: 10.17761/IJYT2017_Research_Babbar_ Epub. PMID: 29131740. **Exclusion: wrong outcome.**
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PMID: 30360536. **Exclusion: wrong study design.**

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529. Thornton YS. Preventing excessive weight gain during pregnancy through dietary and lifestyle counseling: a randomized controlled trial. Obstet Gynecol. 2009 Jul;114(1):173; author reply -4. doi: 10.1097/AOG.0b013e3181ac3aa9. PMID: 19546789. **Exclusion: wrong publication type.**

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533. Timmermans Yeg VDKKDGRDKLMPDEKBWZLJIS-T. Towards Prepared mums (TOP-mums) for a healthy start, a lifestyle intervention for women with overweight and a child wish: study protocol for a randomised controlled trial in the Netherlands. BMJ Open. 2019;9(11) doi: 10.1136/bmjopen-2019-030236. PMID: 31748290. **Exclusion: wrong publication type.**

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PMID: 29049820. **Exclusion: wrong study design.**

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564. Webb JB, Siega-Riz AM, Dole N. Psychosocial determinants of adequacy of gestational weight gain. Obesity (Silver Spring). 2009 Feb;17(2):300-9. doi: 10.1038/oby.2008.490. PMID: 19008871. **Exclusion: wrong study design.**
565. Weisman CS, Hillemeier MM, Downs DS, et al. Preconception predictors of weight gain during pregnancy: prospective findings from the Central Pennsylvania Women's Health Study. Womens Health Issues. 2010 Mar-Apr;20(2):126-32. doi: 10.1016/j.whi.2009.12.002. PMID: 20133152. **Exclusion: wrong study design.**
566. Weisman CS, Hillemeier MM, Downs DS, et al. Improving women's preconceptional health: long-term effects of the Strong Healthy Women behavior change intervention in the central Pennsylvania Women's Health Study. Womens Health Issues. 2011 Jul-Aug;21(4):265-71. doi: 10.1016/j.whi.2011.03.007. PMID: 21536455. **Exclusion: wrong population.**
567. Weisman CS, Misra DP, Hillemeier MM, et al. Preconception predictors of birth outcomes: prospective findings from the central Pennsylvania Women's Health Study. Matern Child Health J. 2011 Oct;15(7):829-35. doi: 10.1007/s10995-009-0473-2. PMID: 19472041. **Exclusion: wrong study design.**
568. Wekker V, Van Dammen L, Van Oers AM, et al. Effect of a lifestyle intervention in obese infertile women on cardiometabolic health and quality of life: results of a randomised controlled trial. Hum Reprod. Conference: 33rd annual meeting of the european society of human reproduction and embryology. Switzerland. 2017;32:i28-i9. **Exclusion: wrong population.**
569. Wells CS, Schwalberg R, Noonan G, et al. Factors influencing inadequate and excessive weight gain in pregnancy: Colorado, 2000-2002. Matern Child Health J. 2006 Jan;10(1):55-62. doi: 10.1007/s10995-005-0034-2 PMID: 16496222. **Exclusion: wrong study design.**

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571. Whitaker KM, Wilcox S, Liu J, et al. Patient and provider perceptions of weight gain, physical activity and nutrition counseling during pregnancy: a qualitative study. Womens Health Issues. 2016 Jan-Feb 11/24;26(1):116-22. doi: 10.1016/j.whi.2015.10.007. PMID: 26621605 **Exclusion: wrong study design.**
572. Wilcox S, Liu J, Addy CL, et al. A randomized controlled trial to prevent excessive gestational weight gain and promote postpartum weight loss in overweight and obese women: Health In Pregnancy and Postpartum (HIPP). Contemp Clin Trials. 2018 Mar;66:51-63. doi: 10.1016/j.cct.2018.01.008. PMID: 29371061. **Exclusion: wrong study design.**
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Randomized Controlled Trials (RCTs) and Cohort Studies

Criteria:

- Initial assembly of comparable groups:
  - For RCTs: Adequate randomization, including first concealment and whether potential confounders were distributed equally among groups
  - For cohort studies: Consideration of potential confounders, with either restriction or measurement for adjustment in the analysis; consideration of inception cohorts
- Maintenance of comparable groups (includes attrition, cross-overs, adherence, contamination)
- Important differential loss to followup or overall high loss to followup
- Measurements: equal, reliable, and valid (includes masking of outcome assessment)
- Clear definition of interventions
- All important outcomes considered
- Analysis: adjustment for potential confounders for cohort studies or intention-to treat analysis for RCTs

Definition of ratings based on above criteria:
Good: Meets all criteria: Comparable groups are assembled initially and maintained throughout the study (followup ≥80%); reliable and valid measurement instruments are used and applied equally to all groups; interventions are spelled out clearly; all important outcomes are considered; and appropriate attention to confounders in analysis. In addition, intention-to-treat analysis is used for RCTs.
Fair: Studies are graded "fair" if any or all of the following problems occur, without the fatal flaws noted in the "poor" category below: Generally comparable groups are assembled initially, but some question remains whether some (although not major) differences occurred with followup; measurement instruments are acceptable (although not the best) and generally applied equally; some but not all important outcomes are considered; and some but not all potential confounders are accounted for. Intention-to-treat analysis is used for RCTs.
Poor: Studies are graded "poor" if any of the following fatal flaws exists: Groups assembled initially are not close to being comparable or maintained throughout the study; unreliable or invalid measurement instruments are used or not applied equally among groups (including not masking outcome assessment); and key confounders are given little or no attention. Intention-to-treat analysis is lacking for RCTs.

Source: Procedure Manual. U.S. Preventive Services Task Force. https://www.uspreventiveservicestaskforce.org/Page/Name/appendix-vi-criteria-for-assessing-internal-validity-of-individual-studies Accessed on 4/12/19.

Appendix A7. Expert Reviewers of the Draft Report

- Patrick Catalano MD, Vice Chair of Obstetrics & Gynecology Research; Professor, Tufts University School of Medicine
- Rebecca Clifton PhD, Associate Research Professor, Milken Institute School of Public Health, George Washington University; Co-Investigator, Maternal Fetal Medicine Units Network, NICHD
- Alan Peaceman MD, Chief of Maternal Fetal Medicine, Professor, Department of Obstetrics and Gynecology, Northwestern University
- Scott K. Winiecki MD, Director, Safe Use Initiative, Professional Affairs and Stakeholder Engagement Staff, Center for Drug Evaluation and Research, U.S. Food and Drug Administration
- Brandy Peaker MD, MPH, Medical Advisor, Office of Public Health Scientific Services, Division of Public Health Information Dissemination, CDC
- Gretchen Buckler MD, MPH, CDR, USPHS Commissioned Corps Medical Officer, Clinical Research Office of Research on Women's Health (ORWH)
- Elena Gorodetsky MD, PhD, Health Scientist Administrator/Research Program Officer, Office of Research on Women's Health (ORWH)

Appendix B Table 1. Included Studies – Study Characteristics

Author, Year Study Name	Study Design	Setting	Population BMI Category	Intervention Type; Intensity	Total N A=Intervention B=Control	Included and Excluded Criteria	Estimated Time	Population Characteristics A=Intervention B=Control	Funding Source	Quality Rating
Aguilar-Cordero et al., 2019[71] SWEP	RCT	One university-affiliated aquatic facility Granada, Spain	Mixed	Active; High intensity	N=140 A. n=70 B. n=70	Included: pregnant women, gestational age 12-20 weeks Excluded: gestational age <12 or >20 weeks, absolute contraindications for aerobic exercise during pregnancy, attendance at <80% of 54 scheduled sessions	1 hour classes 3x per week (planned 54 classes), weeks 20-37	A vs. B Age, mean (SD): 34.5 years (4.5) vs. 33.7 years (5.4) BMI first trimester, median (P25 to P75): 23.9 kg/m^2 (21.5 to 27.5) vs. 24.0 kg/m^2 (21.8 to 26.6) BMI third trimester, median (SD): 27.8 kg/m^2 (4.0) vs. 29.0 kg/m^2 (4.5) Normal weight (BMI 18.5-24.99 kg/m^2): 29.2% vs. 17.2% Overweight (BMI 25-29.99 kg/m^2): 46.2% vs. 48.4% Obese (BMI >30 kg/m^2): 24.6% vs. 34.4% Multiparity: 30.8% vs. 26.6%	No public funding, no conflicts of interest	Fair

Appendix B Table 1. Included Studies – Study Characteristics

Author, Year Study Name	Study Design	Setting	Population BMI Category	Intervention Type; Intensity	Total N A=Intervention B=Control	Included and Excluded Criteria	Estimated Time	Population Characteristics A=Intervention B=Control	Funding Source	Quality Rating
Al Wattar et al., 2019[72] ESTEEM	RCT	5 inner-city maternity units London and Birmingham, UK	Mixed	Counseling; Moderate intensity	N=1,218 A. n=593 B. n=625	Included: Pregnant women aged >16 years, <18 weeks' gestation, singleton, able to consume nuts and olive oil Excluded: preexisting diabetes, GDM, chronic renal disease, autoimmune disease, taking lipid-altering drugs	3 in-person sessions, 2 phone calls	A vs. B Age, mean years (SD): 31.4 (5.2) vs. 30.9 (5.2) Age, >40 years: 3.9% vs. 3.1% BMI normal (15.5-24.9 kg/m^2): 14.2% vs. 13.7% BMI overweight (25-29.9): 16.7% vs. 16.7% BMI obese (30-39.9): 69.1% vs. 69.6% White: 36.6% vs. 35.5% Asian: 43.3% vs. 44.1% Black: 16.4% vs. 17.2% Other: 3.7% vs. 3.3% Primigravida: 27.3% vs. 27.5% Baseline ESTEEM Q score (adherence to Med diet), mean (SD): 5.0 (1.9) vs. 5.0 (1.9)	Barts Charity	Fair

Appendix B Table 1. Included Studies – Study Characteristics

Author, Year Study Name	Study Design	Setting	Population BMI Category	Intervention Type; Intensity	Total N A=Intervention B=Control	Included and Excluded Criteria	Estimated Time	Population Characteristics A=Intervention B=Control	Funding Source	Quality Rating
Altazan et al., 2019[73] Expecting Success / SmartMoms *Note: associated with Redman, 2017	RCT	Clinic or smartphone Baton Rouge, LA	Overweight and obese	Counseling; High intensity	N=54 A. n=37 B. n=17	Included: pregnant women, BMI ≥25 kg/m^2, aged 18-40 years, singleton, no history or current psychotic disorder or major depression, <12 weeks' gestation Excluded: no plans to delivery at Women's Hospital in Baton Rouge, habitual smoker or abuser of drugs in past 6 months, contraindications to exercise	18 lessons (time NR)	A vs. B Age, mean (SD): 29.1 years (4.4) vs. 29.5 years (5.1) BMI enrollment, mean (SD): 31.0 kg/m^2 (4.2) vs. 31.1 kg/m^2 (3.7) BMI overweight (25.0-29.9 kg/m^2): 43.2% (16/37) vs. 52.9% (9/17) BMI obese (30.0-40.0): 56.8% (21/37) vs. 47.1% (8/17) Black: 18.9% vs. 35.3% White: 73% vs. 64.7% Other: 8.1% vs. 0% Gestational age, mean weeks (SD): 10.2 (1.2) vs. 9.6 (1.0)	NIDDK, NHLBI, NCCIH, NIH ORWH, ODP, OBSSR, NIGMS	Fair
Althuizen et al., 2013[74] New Life(style)	RCT	Eight midwifery clinics, Netherlands	Mixed	Counseling; Moderate intensity	N=246 A. n=123 B. n=123	Included: Pregnant women <14 weeks gestation, expecting first child, ability to read, write, and speak Dutch.	30-min phone call; three 15-min in person; one 15-min phone call	A vs. B Age, mean (SD): 29.1 years (3.8) vs. 30.4 years (4.0) Prepregnancy BMI, mean (SD): 24.0 kg/m^2 (4.2) vs. 23.5 kg/m^2 (3.8) Underweight: 10% vs. 14% Normal weight: 66% vs. 67% Overweight: 9% vs. 8% Obese: 14% vs. 12% Race: NR	Grant from Netherlands Organization for Health Research and Development	Good

Appendix B Table 1. Included Studies – Study Characteristics

Author, Year Study Name	Study Design	Setting	Population BMI Category	Intervention Type; Intensity	Total N A=Intervention B=Control	Included and Excluded Criteria	Estimated Time	Population Characteristics A=Intervention B=Control	Funding Source	Quality Rating
Asbee et al., 2009[75]	RCT	One prenatal care center, Charlotte, North Carolina	Mixed	Counseling; Low intensity	N=144 A. n=57 B. n=43	Included: Women between 6-16 weeks of gestation, aged 18-49 years, all prenatal care received at the Resident Obstetrics Clinic, singleton pregnancy, speaks English or Spanish Excluded: BMI >40 kg/m^2, preexisting diabetes, untreated thyroid disease, or hypertension requiring medication or other medical conditions that might affect body weight, delivery at institution other than Carolinas Medical Center-Main, pregnancy ending in preterm birth (<37 weeks), limited prenatal care (<4 visits)	NR - one initial study visit	A vs. B Age, mean: 26.7 years vs. 26.4 years Prepregnancy BMI, mean: 25.5 kg/m^2 vs. 25.6 kg/m^2 Prepregnancy weight, mean: 143.0 lbs vs. 143.2 lbs Hispanic: 57.9% vs. 54.8% Black: 26.3% vs. 21.4% White: 8.8% vs. 19.0% Asian: 5.3% vs. 2.4% Other: 1.8% vs. 2.4%	Grant from Carolinas Healthcare Foundation	Fair
Assaf-Balut et al., 2017[76]	RCT	One hospital-affiliated clinic, Madrid, Spain	Mixed	Counseling; Low intensity	N=1,000 A. n=500 B. n=500	Included: pregnant women, singleton, aged ≥18 years Excluded: gestational age >14 weeks, intolerance to nuts or olive oil, medical conditions or pharmacological therapy that could compromise effect of intervention or follow-up	1 hour initial study visit	A vs. B Age, mean (SD): 33.2 years (5.0) vs. 32.7 years (5.3) Baseline BMI, mean (SD): 23.7 kg/m^2 (3.8) vs. 24.1 kg/m^2 (4.1) White: 69.0% vs. 67.8% Hispanic: 28.6% vs. 28.4% Other: 2.4% vs. 3.8%	Fundacion para Estudios Endocrinometabolicos, IdISSC Hospital Clinico San Carlos, Instituto de Salud Carlos III of Spain, Fondo Europeo de Desarrollo Regional	Good

Appendix B Table 1. Included Studies – Study Characteristics

Author, Year Study Name	Study Design	Setting	Population BMI Category	Intervention Type; Intensity	Total N A=Intervention B=Control	Included and Excluded Criteria	Estimated Time	Population Characteristics A=Intervention B=Control	Funding Source	Quality Rating
Bacchi et al., 2018[77]	RCT	One primary care obstetric clinic, Buenos Aires, Argentina	Mixed	Active; High intensity	N=140 A. n=70 B. n=70	Included: Pregnant women, singleton, uncomplicated pregnancies Excluded: Women not planning to give birth at study obstetric clinic, not under medical care throughout pregnancy period, women with conditions preventing them from exercising safely, heart disease, thrombophlebitis, cervical incompetence, multiple pregnancy, vaginal bleeding, premature leakage of membranes, intrauterine growth restriction, preeclampsia, risk of premature labor, prepregnant T1D or T2D	55-60 min 3x per week	A vs. B Age, mean (SD): 30.4 years (4) vs. 31.0 years (5) Baseline BMI, mean (SD): 23.1 kg/m^2 (3.2) vs. 24.0 kg/m^2 (4) BMI underweight (<18 kg/m^2): 2% vs. 3.2% BMI normal weight (18-24.9): 65.3% vs. 58.1% BMI overweight (25-29.0): 26.5% vs. 30.6% BMI obese (≥30): 6.1% vs. 8.1% Race: NR	Technical University of Madrid; Spanish Ministry of Culture, Education, and Sport; University of Flores	Fair
Barakat et al., 2012[78]	RCT	One primary care obstetric clinic, Madrid, Spain	Mixed	Active; High intensity	N=100 A. n=50 B. n=50	Included: Pregnant women, singleton, gestational age 6-9 weeks, uncomplicated pregnancies Excluded: Women not planning to give birth at study obstetric clinic, not under medical care throughout pregnancy period, women with absolute obstetric contraindication, heart disease, thrombophlebitis, recent pulmonary embolism, acquired infectious disease, cervical incompetence, multiple pregnancy, genital hemorrhage, premature leakage of membranes, intrauterine growth restriction, macrosomia, serious blood disease, serious HTN, absence of prenatal control, suspects of fetal suffering, risk of premature labor, prepregnant T1D or T2D	35-45 min 3x per week	A vs. B Age, mean (SD): 32 years (4) vs. 31 years (3) Baseline BMI, mean (SD): 22.7 kg/m^2 (2.8) vs. 23 kg/m^2 (2.9) Race: NR	Ministerio de Ciencia e Innovación, Spain	Fair

Appendix B Table 1. Included Studies – Study Characteristics

Author, Year Study Name	Study Design	Setting	Population BMI Category	Intervention Type; Intensity	Total N A=Intervention B=Control	Included and Excluded Criteria	Estimated Time	Population Characteristics A=Intervention B=Control	Funding Source	Quality Rating
Barakat et al., 2014[81]	RCT	One maternity care hospital, Madrid, Spain	Mixed	Active; High intensity	N=251 A. n=137 B. n=114	Included: Pregnant women at 6 to 7 weeks of pregnancy living in Madrid, Spain Excluded: Any type of absolute obstetrical contraindication to exercise as suggested by ACOG; not planning to give birth in the obstetrics department of the study hospital, not receiving medical followup throughout the pregnancy, participating in another physical program or having a high level of pregestational physical exercise	55-60 min 3x per week	A vs. B Age (mean): 31 years vs. 31 years Baseline BMI, mean: 23.8 kg/m^2 vs. 24.1 kg/m^2 Baseline BMI <18 kg/m^2: 9% vs. 2.2% Baseline BMI 18-24.9 kg/m^2: 68.9% vs. 34.4% Baseline BMI 25-29.9 kg/m^2: 23.6% vs. 23.3% Baseline BMI >30 kg/m^2: 6.6% vs. 10%	Technical University of Madrid and University of Flores-Argentina	Fair
Barakat et al., 2016[80]	RCT	One hospital, Madrid, Spain	Mixed	Active; High intensity	N=840 A. n=420 B. n=420	Included: Caucasian, spoke Spanish, singleton, gestational age 9-11 weeks, uncomplicated pregnancy, no history or risk of preterm delivery Excluded: preexisting T1D or T2D, GDM at baseline, not under medical care during pregnancy, not planning to give birth at study hospital, any serious medical contraindications to exercise	55-60 min 3x per week	A vs. B Age, mean (SD): 31.6 years (4.2) vs. 31.8 years (4.5) BMI, mean (SD): 23.6 kg/m^2 (3.8) vs. 23.4 kg/m^2 (4.2) Underweight: 2.6% vs. 5.2% Normal: 67.5% vs. 67.6% Overweight: 23.3% vs. 19.6% Obese: 6.5% vs. 7.6%	Technical University of Madrid	Fair

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Barakat et al., 2018[79]	RCT	2 primary care medical centers Madrid, Spain	Mixed	Active; High intensity	N=429 A. n=202 B. n=227	Included: singleton, no preexisting GDM or diabetes, gestational age 9-11 weeks, no history or risk of preterm delivery, no other trial participation Excluded: not planning to give birth at study hospital, no medical follow-up, contraindications to exercise during pregnancy	55-60 min 3x per week	A vs. B Age, mean (SD): 31.8 years (4.6) vs. 31.3 years (3.4) BMI, mean (SD): 23.4 kg/m^2 (3.7) vs. 23.7 kg/m^2 (3.8) BMI underweight (<18 kg/m^2): 1.8% vs. 2% BMI normal (18-24.9): 70.5% vs. 71.6% BMI overweight (25-29.9): 21.9% vs. 19.9% BMI obese (>30): 5.8% vs. 6.5% Nulliparous: 62.1% vs. 70.3% Smoker: 18.2% 22.1% Cesarean: 22.5% vs. 25.2%	NR; authors report no conflicts of interest	Fair
Barakat et al., 2019[82]	RCT	2 tertiary care hospitals Madrid, Spain	Mixed	Active; High intensity	N=456 A. n=234 B. n=222	Included: singleton, gestational age 8-10 weeks, no preexisting GDM or diabetes, no history or risk of preterm delivery, no other trial participation Excluded: not planning to give birth at study hospital, no medical follow-up, contraindications to exercise during pregnancy	55-60 min 3x per week	A vs. B Age, mean years (SD): 31.8 (4.7) vs. 31.0 (3.8) BMI baseline, mean (SD): 23.5 kg/m^2 (3.8) vs. 23.7 kg/m^2 (3.8) BMI underweight (<18 kg/m^2): 2.1% vs. 2.7% BMI normal (18-24.9): 68.4% vs. 70.7% BMI overweight (25-29.9): 23.1% vs. 20.3% BMI obese (>30): 6.4% vs. 6.3% Nulliparous: 60.7% vs. 73%	NR; authors report no conflicts of interest	Fair

Appendix B Table 1. Included Studies – Study Characteristics

Author, Year Study Name	Study Design	Setting	Population BMI Category	Intervention Type; Intensity	Total N A=Intervention B=Control	Included and Excluded Criteria	Estimated Time	Population Characteristics A=Intervention B=Control	Funding Source	Quality Rating
Bogaerts et al., 2013[83]	RCT	Three hospital-based antenatal units, Belgium	Obese	Counseling; Moderate intensity	N=205 A. n=76 B. n=58 C. n=63	Included: Obese (BMI ≥29 kg/m^2) pregnant women <15 weeks of pregnancy attending antenatal clinic at 3 regional hospitals in Belgian Flanders between March 2008 and April 2011 Excluded: preexisting type 1 diabetes, multiple pregnancy	Four 1.5-2 hour in person groups	A vs. B vs. C Age, mean (SD): 28.8 years (4.5) vs. 29.6 years (4.9) vs. 28.7 years (4.2) Prepregnancy BMI, mean, (SD): 34.4 kg/m^2 (4.6) vs. 35.4 kg/m^2 (5.2) vs. 34.4 kg/m^2 (4.1) Belgian/Dutch ethnicity: 81.6% vs. 81% vs. 77.8% Turkish/Moroccan ethnicity: 10.5% vs. 13.8% vs. 14.3 Other ethnicity: 7.9% vs. 5.2% vs. 7.9%	PWO project from Flanders, FWO Vlaanderen Netherland organization for Scientific Research, European Commission's seventh Framework Programme	Fair
Brownfoot et al., 2016[84]	RCT	One tertiary obstetric hospital, Melbourne, Australia	Mixed	Counseling; Low intensity	N=782 A. n=386 B. n=396	Included: women 18-45 years old, singleton pregnancy, attending first antenatal visit prior to 21 weeks, planning to receive care through hospital clinics. Excluded: medical comorbidities, substance abuse, inability to understand English	NR - during visits	A vs. B Age, mean (SD): 31.6 years (4.9) vs. 32.3 years (4.7) BMI normal weight (18-24.9 kg/m^2): 53.9% vs. 53.5% BMI overweight (25-29.9): 29% vs. 29.3% BMI obese (≥30): 15.5% vs. 14.7% White: 55% vs. 54% Asian: 13% vs. 15% Middle East: 4% vs. 4% Other: 27% vs. 27%	Victorian Managed Insurance Agency	Fair

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Author, Year Study Name	Study Design	Setting	Population BMI Category	Intervention Type; Intensity	Total N A=Intervention B=Control	Included and Excluded Criteria	Estimated Time	Population Characteristics A=Intervention B=Control	Funding Source	Quality Rating
Bruno et al., 2017[85]	RCT	One university hospital, Modena, Italy	Overweight and obese	Counseling; Moderate intensity	N=191 A. n=96 B. n=95	Included: women >18 years old, BMI ≥ 25 kg/m^2, singleton, gestational age 9-12 weeks Excluded: preexisting diabetes, history of GDM, GDM in first trimester, hypertension, medical conditions that could affect body weight (e.g. thyroid disease), prior bariatric surgery, contraindications to exercise, plans to delivery outside the study hospital, smoking 5+ cigarettes per day	1 hour initial study visit; four follow-up visits (time NR)	A vs. B Age, mean (SD): 31.5 years (5) vs. 30.8 years (5.5) Prepregnancy BMI, mean (SD): 33.3 kg/m^2 (6) vs. 33.4 kg/m^2 (5.5) BMI at enrollment: 33.9 kg/m^2 (5.7) vs. 34.5 kg/m^2 (6.8) Obese: 65.6% vs. 72.6% White: 82.3% vs. 82.1% African: 12.6% vs. 13.7% Other: 5.2% vs. 4.3%	Policlinico university Hospital of Modena	Fair
Cahill et al., 2018[86] PreGO	RCT	One university hospital, St. Louis, Missouri	Overweight and obese	Counseling; High intensity	N=240 A. n=119 B. n=121	Included: African American, age 18-45, BMI 25-45 at initial first trimester visit, single viable gestation at or before 15 0/7 weeks (by LMP), disadvantaged SES (Medicaid recipient or home zip code associated with median household income below FPL) Excluded: diabetes, history of GDM or contraindication macrosomia, HbA1c ≥6.5%, any contraindication to exercise during pregnancy, substance abuse, non-English speaker	10 biweekly 1-hour visits	A vs. B Age, mean (SD): 24.7 years (4.9) vs. 26.0 years (4.9), p=0.04 BMI, mean (SD): 32.8 kg/m^2 (5.1) vs. 31.9 kg/m^2 (4.9) Race: NR	NIH	Good

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Haire-Joshu et al., 2019[103] *Note: f/u of Cahill et al., 2018	Same as Cahill et al., 2018	Same as Cahill et al., 2018	Same as Cahill et al., 2018	Same as Cahill et al., 2018	N=185 A. n=92 B. n=93	Same as Cahill et al., 2018	10 prenatal biweekly visits, 12 monthly postpartum visits (1 hour)	A vs. B (2019 sample) Age, mean (SD): 24.7 years (5) vs. 26.2 years (5) BMI baseline, mean (SD): 32.7 kg/m^2 (5.2) vs. 31.9 kg/m^2 (5) BMI overweight: 33.7% vs. 35.6% BMI obese: 66.3% vs. 63.4% Nulliparous: 25% vs. 18.3% GDM: 10.9% vs. 9.7%	NIH	Fair
Claesson et al., 2010[87]	CCT	Multiple antenatal care clinics, Sweden	Obese	Active; High intensity	N=348 A. n=155 B. n=193	Included: BMI ≥30 kg/m^2, speak Swedish, mean gestational age 15 weeks, singleton pregnancy, registered at antenatal care clinics in Linköping and surrounding area (intervention) or two nearby cities (control) Excluded: Prepregnant diabetes, thyroid dysfunction, psychiatric condition treated with neuroleptic drugs, had miscarriage or legal abortion during study	Weekly 30-min in person; 1-2x per week exercise class (time NR), 3 follow-up visits (time NR)	A vs. B Age, mean (SD): 29.7 years (4.48) vs. 30.2 years (4.92) BMI Class I obese (30-34.9 kg/m^2): 64.5% vs. 65.8% BMI Class II obese (35-39.9): 23.2% vs. 21.8% BMI Class III obese (≥40): 12.3% vs. 12.4%	The Research Fund of County Council in the South East Sweden and ALF, Council of Östergötland	Fair
Daley et al., 2015[88]	RCT	One community midwifery clinic, Birmingham, UK	Mixed	Counseling; Low intensity	N=76 A. n=36 B. n=40	Included: Pregnant women, ≥18 years old, BMI 18-29.9 kg/m^2, 12-14 weeks' gestation Excluded: Obese women (BMI ≥30 kg/m^2), women with high-risk pregnancies	NR - during visits	A vs. B Age, mean (SD): 28.1 years (5.9) vs. 28.9 years (6.8) BMI normal weight (18.5-24.9 kg/m^2): 57.5% vs. 55.6% BMI overweight (25.0-29.9): 42.5% vs. 44.4% White ethnicity: 85.0% vs. 91.7%	NIHR	Fair

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Daley et al., 2019[89] POPS2	RCT	Four maternity centers, England	Mixed	Counseling; Low intensity	N=616 A. n=305 B. n=311	Included: singleton, ≥18 years old, BMI ≥18.5 kg/m^2, expected to receive midwife-led or shared care, 10-14 weeks' gestation. Excluded: unable to understand English, attend weight management program, severe mental illness, illicit drug or alcohol dependency	NR – during visits	A vs. B Age, mean (SD): 29.4 years (5.0) vs. 29.7 years (5.2) BMI mean (SD): 25.9 kg/m^2 (4.6) vs. 26.1 kg/m^2 (4.8) BMI normal weight (18.5-24.9 kg/m^2): 49.2% vs. 48.9% BMI overweight (25-29.9): 31.5% vs. 32.2% BMI obese (≥30): 19.3% vs. 18.8% Caucasian: 73.5% vs. 72.8% Pakistani: 10.4% vs. 11.9% IMD most deprived: 44.3% vs. 44.9% Smoker: 8.5% vs. 6.3%	NIHR	Fair
Daly et al., 2017[90] Healthy eating, Exercise and Lifestyle Trial	RCT	One university hospital, Dublin, Ireland	Obese	Active; High intensity	N=88 A. n=44 B. n=44	Included: Pregnant women <17 weeks' gestation, BMI ≥30 kg/m^2 at first prenatal visit, understood English, ≥18 years old Excluded: multiple pregnancy, preexisting diabetes, hypertension, alcohol or drug abuse, medication affecting insulin secretion or sensitivity, serious cardiorespiratory disorders, hepatic or renal impairment, lupus, hematologic disorders, celiac disease, thyroid disorders, current psychosis, malignant disease, known fetal anomaly	50-60 min 3x per week	A vs. B Age, mean (SD): 30.0 years (5.1) vs. 29.4 years (4.8) BMI, mean (SD): 34.7 kg/m^2 (4.6) vs. 34.7 kg/m^2 (5.1) Race: NR	Friends of the Coombe	Fair

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Author, Year Study Name	Study Design	Setting	Population BMI Category	Intervention Type; Intensity	Total N A=Intervention B=Control	Included and Excluded Criteria	Estimated Time	Population Characteristics A=Intervention B=Control	Funding Source	Quality Rating
Dodd et al., 2014[56] LIMIT	RCT	Three maternity hospitals, Adelaide, Australia	Overweight and obese	Counseling; Moderate intensity	N=2,212 A. n=1,108 B. n=1,104	Included: Singleton, BMI ≥25 kg/m^2, between 10-20 weeks' gestation Excluded: preexisting diabetes	3 in-person visits; 3 phone calls (time NR)	A vs. B Age, mean (SD): 29.3 years (5.4) vs. 29.6 years (5.6) Median BMI (IQR): 31.0 kg/m^2 (28.1-35.9) vs. 31.1 kg/m^2 (27.7-35.6) BMI overweight (25-29.9 kg/m^2): 41.4% vs. 42.7% BMI Class I obese (30.0-34.9): 29.5% vs. 29.0% BMI Class II obese (35.0-39.9): 18.3% vs. 16.7% BMI Class III obese (≥40): 10.8% vs. 11.7% White: 90% vs. 91% Asian: 2.4% vs. 3.1% Indian: 3.6% vs. 3.2% Other: 4.0% vs. 2.7%	University of Adelaide, NHMRC Practitioner Fellowship	Good
Dodd et al., 2018[91] *Note: f/u of Dodd et al., 2014	Same as Dodd et al., 2014	Same as Dodd et al., 2014	Same as Dodd et al., 2014	Same as Dodd et al., 2014	Same as Dodd et al., 2014	Same as Dodd et al., 2014	Same as Dodd et al., 2014	Same as Dodd et al., 2014	Same as Dodd et al., 2014	Same as Dodd et al., 2014

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Dodd et al., 2019[92] OPTIMISE	RCT	One hospital, Adelaide, Australia	Normal	Counseling; Moderate intensity	N=633 A. n=316 B. n=317	Included: Singleton, BMI 18.5-24.9 kg/m^2, between 10-20 weeks' gestation Excluded: multiple pregnancy, preexisting diabetes	3 in-person visits; 3 phone calls (time NR)	A vs. B Age, mean (SD): 31.6 years (4.6) vs. 31.5 years (4.6) BMI, median (IQR): 22.2 kg/m^2 (20.8, 23.7) vs. 22.2 kg/m^2 (20.9, 23.5) Caucasian: 67.1% vs. 67.8% Asian: 15.8% vs. 14.2% Indian, Pakistani, Sri Lankan: 7% vs. 9.2% Nulliparous: 59.8% vs. 58.7% Smoker: 4.8% vs. 4.1% Socioeconomic Index for Areas, most disadvantaged: 15.2% vs. 18.3%	University of Adelaide, NHMRC Practitioner Fellowship	Good
Epel et al., 2019[93] MMT	Prospective cohort	Hospital and community health centers San Francisco, CA	Overweight and obese	Counseling; High intensity	N=215 A. n=110 B. n=105	Included: aged 18-45 years, singleton, BMI 25-41 kg/m^2, gestational age 12-19 weeks, able to attend 8 weekly 2-hr classes, household income <500% FPL Excluded: not able to complete forms in English, have substance abuse / mental health / medical condition making it difficult to participate in group class or affect GWG, needle phobia or fainting response, PCOS tx with metformin, meditation practice >2x/week, recent weight loss (>5% in 6 months), chronic corticosteroids, hx of gastric bypass surgery	1 initial session, 8 group classes (2 hours 1x/wk), 2 phone calls (time NR), 1 postpartum group session	A vs. B Age, mean (SD): 27.8 years (5.7) vs. 28 years (6) BMI normal or overweight (BMI <30 kg/m^2): 55.2% vs. 51% BMI Class I obese (30-34.9): 28.6% vs. 24% BMI Class II obese (≥35): 16.2% vs. 25% White: 12.8% vs. 14.3% African-American: 35.8% vs. 42.9% Latino: 32.1% vs. 27.6% Other: 19.2% vs. 15.2%	NHLBI	Good

Appendix B Table 1. Included Studies – Study Characteristics

Author, Year Study Name	Study Design	Setting	Population BMI Category	Intervention Type; Intensity	Total N A=Intervention B=Control	Included and Excluded Criteria	Estimated Time	Population Characteristics A=Intervention B=Control	Funding Source	Quality Rating
Gallagher et al., 2018[94] LIFT	RCT	Multiple hospital-affiliated clinics, U.S.	Overweight and obese	Counseling; High intensity	N=210 A. n=105 B. n=105	Included: age ≥18 years, BMI ≥25 kg/m^2, singleton pregnancy, gestation age 9-15 weeks and 6 days, intent to deliver at St. Luke's-Roosevelt hospital Excluded: Prepregnant diabetes, known fetal anomaly, planned termination of pregnancy, history of ≥3 consecutive first trimester miscarriages, current eating disorder, suicidal ideation, planned bariatric surgery, current use of metformin, steroids, or certain psych drugs, use of weight loss medication, contraindications to exercise in pregnancy, drug/alcohol addition, smoker, chronic health problems precluding regular exercise	3 visits	A vs. B Age, mean (SD): 33.8 years (4.0) vs. 33.8 years (4.7) Baseline BMI, mean (SD): 30.1 kg/m^2 (4.1) vs. 30.7 kg/m^2 (5.0) BMI overweight (25-29.9 kg/m^2): 62% vs. 57% BMI obesity (≥30): 38% vs. 43% White: 46% vs. 48% Black: 24% vs. 24% Other: 25% vs. 21% More than one: 5% vs. 8% Hispanic: 30% vs. 24%	NIH grants (NIDDKD, NHLBI, NICHHD, NCCIH, ORWH, OBSSR, IHS)	Fair
Garnaes et al., 2016[97] ETIP	RCT	Two university hospitals Trondheim, Norway	Overweight and obese	Active; High intensity	N=91 A. n=46 B. n=45	Included: BMI ≥28 kg/m^2; age ≥18 years, gestational week <18, carrying one singleton live fetus at 11-14 week ultrasound, able to come to hospital for assessments an exercise classes Excluded: high risk for preterm labor, diseases that could interfere with participation, and habitual exercise training (twice or more weekly) in the period before <18 weeks' gestation	60 mins sessions 3x per week	A vs. B Age, mean (SD): 31.3 years (3.8) vs. 31.4 years (4.7) BMI, mean (SD): 33.9 kg/m^2 (3.8) vs. 35.1 kg/m^2 (4.6) BMI overweight (28-29.9 kg/m^2): 6.6% vs. 11.1% BMI Class I obese (30-34.9): 62.2% vs. 42.2% BMI Class II obese (35-39.9): 24.4% vs. 33.3% BMI Class III obese (≥40): 6.6% vs. 13.3% Race: NR	Norwegian fund for post-graduate training supported by NOK grant; Regional health authority and University	Fair
Garnaes et al., 2017[98] *Note: f/u of Garnaes et al., 2016	Same as Garnaes et al., 2016	Same as Garnaes et al., 2016	Same as Garnaes et al., 2016	Same as Garnaes et al., 2016	Same as Garnaes et al., 2016	Same as Garnaes et al., 2016	Same as Garnaes et al., 2016	Same as Garnaes et al., 2016	Same as Garnaes et al., 2016	Same as Garnaes et al., 2016

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Garnaes et al., 2018[96] *Note: f/u of Garnaes et al., 2016	Same as Garnaes et al., 2016	Same as Garnaes et al., 2016	Same as Garnaes et al., 2016	Same as Garnaes et al., 2016	Same as Garnaes et al., 2016	Same as Garnaes et al., 2016	Same as Garnaes et al., 2016	A vs. B (2018 analysis) Age, mean (SD): 31.6 years (3.6) vs. 31.3 years (4.6) BMI baseline, mean (SD): 33.9 kg/m^2 (3.8) vs. 35.2 kg/m^2 (4.5) BMI overweight (<30 kg/m^2): 5.6% vs. 8.8% BMI Class I obese (30-34.9): 63.9% vs. 44.1% BMI Class II obese (35-39.9): 25% vs. 32.4% BMI Class III obese (≥40): 5.6% vs. 14.7% Primiparous: 50% vs. 44.1%	Same as Garnaes et al., 2016	Good
Garnaes et al., 2019[91] *Note: f/u of Garnaes et al., 2016	Same as Garnaes et al., 2016	Same as Garnaes et al., 2016	Same as Garnaes et al., 2016	Same as Garnaes et al., 2016	Same as Garnaes et al., 2016	Same as Garnaes et al., 2016	Same as Garnaes et al; 2016; 3 months postpartum followup	Same as Garnaes et al., 2016	Same as Garnaes et al., 2016	Fair
Gesell et al., 2015[99] Madre Sana, Bebé Sano / Healthy Mother, Healthy Baby	RCT	Community center, Nashville, Tennessee	Mixed	Active; High intensity	N=135 A. n=68 B. n=67	Included: Between 10-28 weeks' gestation, aged ≥16 years, in prenatal care, English or Spanish speaking, expecting to remain in Middle Tennessee for pregnancy, signed release form for medical abstraction Excluded: None based on prior pregnancies or other medical conditions	12 weekly 90-min group sessions	A vs. B Age, mean (SD): 27.6 years (5.8) vs. 25. 9 years (6) Hispanic: 43% vs. 37% White: 1% vs. 5% African-American: 3% vs. 6% Other: 3% vs. 1%	State of Tennessee department of health, NICH K23, national center for advancing translational sciences	Fair

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Gray-Donald, et al., 2000[100]	CCT	Community-based prenatal clinics in Cree villages, Quebec	Mixed	Counseling; Moderate intensity	N=219 A. n=112 B. n=107	Included: All Cree women receiving prenatal services prior to 26 weeks gestation in Cree communities during certain time periods. Excluded: pregestational diabetes, serious health problems	NR	A vs. B Age, mean (SD): 24.3 years (6.3) vs. 23.8 years (5.9) BMI, mean (SD): 30.8 kg/m^2 (6.9) vs. 29.6 kg/m^2 (6.5) Cree: 100%	NHRDP	Fair
Guelfi et al., 2016[101]	RCT	Home-based supervised exercise Perth, Australia	Mixed	Active; High intensity	N=172 A. n=85 B. n=87	Included: pregnant women with history of GDM, <14 weeks gestation, aged >18 years, able to participate in exercise program Excluded: women with preexisting diabetes, elevated baseline OGTT, multiple pregnancy, contraindication to exercise during pregnancy	3 sessions per week (20-60 min) from weeks 14 to 28	A vs. B Age, mean (SD): 33.6 years (4.1) vs. 33.8 years (3.9) BMI normal weight (<25 kg/m^2): 44% vs. 55% BMI overweight (25-29.9): 35% vs. 22% BMI obese (≥30): 21% vs. 23% Caucasian: 89% vs. 78%	National Health and Medical Research Council of Australia	Fair
Haakstad et al., 2011[102]	RCT	Community location, Oslo, Norway	Mixed	Active; High intensity	N=105 A. n=52 B. n=53	Included: Nulliparous women who had not participated in structured exercise program (>60 min q weekly) or brisk walking (>120 min q weekly) in prior 6 months; ability to read, understand, speak Norwegian; duration of pregnancy ≤24 weeks. Excluded: History of ≥2 miscarriages, severe heart disease, persistent bleeding after 12 weeks' gestation, multiple pregnancy, poorly controlled thyroid disease, pregnancy-induced HTN or eclampsia, other diseases preventing participation, not able to attend weekly exercise classes.	60 mins 2x week for 12 weeks	A vs. B Age, mean (SD): 31.2 years (3.7) vs. 30.3 years (4.4) Prepregnancy BMI, mean (SD): 23.8 kg/m^2 (3.8) vs. 23.9 kg/m^2 (4.7) Race: NR	NR; authors declare no conflict of interest	Fair

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Author, Year Study Name	Study Design	Setting	Population BMI Category	Intervention Type; Intensity	Total N A=Intervention B=Control	Included and Excluded Criteria	Estimated Time	Population Characteristics A=Intervention B=Control	Funding Source	Quality Rating
Harrison et al., 2013[104] HeLP-her	RCT	Three teaching hospitals, Victoria, Australia	Overweight and obese	Counseling; Moderate intensity	N=228 A. n=121 B. n=107	Included: Women 12-15 weeks' gestation, overweight (if Polynesian, Asian, or African) or obese (if other ethnicities) and at increased risk of GDM by a validated risk prediction tool, Excluded: multiple pregnancies, preexisting diabetes, BMI ≥45 kg/m^2, preexisting chronic conditions, non-English speaking	4 sessions	A vs. B Age, mean (SD): 32.4 years (4.6) vs. 31.7 years (4.5) BMI, mean: 30.4 kg/m^2 (5.6) vs. 30.3 kg/m^2 (5.9) BMI ≥30: 52% vs. 43%	International Diabetes Federation; Lilly Diabetes; Jack Brockhoff Foundation	Good
Harrison et al., 2014[105] *Note: f/u of Harrison et al., 2013	Same as Harrison et al., 2013	Same as Harrison et al., 2013	Same as Harrison et al., 2013	Same as Harrison et al., 2013	Same as Harrison et al., 2013	Same as Harrison et al., 2013	Same as Harrison et al., 2013	Same as Harrison et al., 2013	Same as Harrison et al., 2013	Same as Harrison et al., 2013
Hawkins et al., 2014[106] Estudio Vida	RCT	Two medical centers, Massachusetts	Overweight and obese	Counseling; Moderate intensity	N=68 A. n=33 B. n=35	Included: Overweight and obese pregnant Hispanic women aged 18-40 years, gestational week <18, and reporting <30 minutes of moderate-to-vigorous physical activity per week Exclude: preexisting diabetes, hypertension, heart disease, chronic renal disease, medications affecting glucose tolerance	1 in-person session per month for 6 months, 5 phone booster sessions	A vs. B Age ≤20 years: 18% vs. 9% Age 21-24 years: 42% vs. 40% Age 25-28 years: 15% vs. 23% Age ≥29 years: 24% vs. 29% BMI overweight (25-29.9 kg/m^2): 46% vs. 51% BMI obese (≥30): 55% vs. 49%	CDC/ASPH	Fair
Herring et al., 2016[108]	RCT	Two hospital-affiliated obstetric clinics, Philadelphia, Pennsylvania	Overweight and obese	Counseling; High intensity	N=66 A. n=33 B. n=33	Included: Overweight and obese pregnant African American women age ≥18 years, <20 weeks' gestation, singleton and receiving Medicaid Exclude: women with conditions requiring specialized nutritional care, used tobacco	1 in-person session, 7 calls over 12 weeks	A vs. B Age, mean (SD) : 25.9 years (4.9) vs. 25.0 years (5.7) BMI, mean (SD): 33.5 kg/m^2 (5.8) vs. 32.2 kg/m^2 (5.4) Black: 100%	NIH, HRSA	Fair
Herring et al., 2017[107] Note: f/u of Herring et al., 2016	Same as Herring et al., 2016	Same as Herring et al., 2016	Same as Herring et al., 2016	Same as Herring et al., 2016	Same as Herring et al., 2016	Same as Herring et al., 2016	Same as Herring et al., 2016	Same as Herring et al., 2016	Same as Herring et al., 2016	Same as Herring et al., 2016

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Author, Year Study Name	Study Design	Setting	Population BMI Category	Intervention Type; Intensity	Total N A=Intervention B=Control	Included and Excluded Criteria	Estimated Time	Population Characteristics A=Intervention B=Control	Funding Source	Quality Rating
Hui et al., 2012[110]	RCT	One prenatal clinic, Winnipeg, Manitoba	Mixed	Active; High intensity	N=224 A. n=112 B. n=112	Included: Nondiabetic pregnant women <26 weeks of pregnancy, living in Winnipeg Excluded: NR	30-45 mins per session 3-5x per week	A vs. B Age, mean (SD): 30.1 years (5.2) vs. 28.7 years (5.9) BMI, mean (SD): 24.9 kg/m^2 (5.4) vs. 25.7 kg/m^2 (5.1) First Nations: 17.4% vs. 25.0%	Lawson Foundation, the Canadian Institutes of Health Research and the Public Health Agency of Canada	Fair
Hui et al., 2014[111]	RCT	Community location, Winnipeg, Manitoba	Mixed	Active; High intensity	N=113 A. n=57 B. n=56	Included: Pregnant women <20 weeks of pregnancy, no existing diabetes during pregnancy, who lived in Winnipeg, Manitoba between May 2009 and December 2011 Excluded: Medical or obstetric contraindication for exercise during pregnancy	30-45 mins per session 3-5x per week	A vs. B Age, mean (SD), normal weight: 31 years (3) vs. 29 years (6) Age, mean (SD), overweight: 31 years (4) vs. 32 years (5) BMI, mean (SD), normal weight: 21.6 kg/m^2 (2.2) vs. 22.6 kg/m^2 (1.9) BMI, mean (SD), overweight: 29.5 kg/m^2 (5.1) vs. 29.7 kg/m^2 (1.3) First Nations, normal weight: 6.7% vs. 3.7% First Nations, overweight: 11.1% vs. 13.8%	Canadian Institutes of Health Research, the Lawson Foundation, the Public Health Agency of Canada	Fair

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Author, Year Study Name	Study Design	Setting	Population BMI Category	Intervention Type; Intensity	Total N A=Intervention B=Control	Included and Excluded Criteria	Estimated Time	Population Characteristics A=Intervention B=Control	Funding Source	Quality Rating
Koivusalo et al., 2016[114] RADIEL	RCT	Four maternity hospitals, Finland	Obese	Counseling; Moderate intensity	N=293 A. n=155 B. n=138	Included: aged ≥18 years, BMI ≥30 kg/m^2 or history of GDM in a previous pregnancy (dx >20 weeks), women who had at least one OGTT done after delivery *Specific to Koivusalo 2016 and Rono 2018b: women <20 weeks' gestation Excluded: Preexisting diabetes (FPG ≥7.0 mmol/L, 2-hr PGL ≥11.1 mmol/L in 75 g OGTT, HbA1c ≥48 mmol/mol), medication that influences glucose metabolism (e.g., oral corticosteroids or metformin), multiple pregnancy, physical disability that prevents regular exercise, current substance abuse, severe psychiatric disorder (i.e., psychotic disorders, schizophrenia, or schizoaffective disorders), or inadequate Finnish language skills *Specific to Koivusalo 2016: women with current dx of GDM <20 weeks' gestation	Three 2-hour sessions	RADIEL: normal OGTT sample A vs. B Age, mean (SD): 32.3 years (4.9) vs. 32.6 years (4.5) Prepregnancy BMI, mean (SD): 31.5 kg/m^2 (6.0) vs. 32.0 kg/m^2 (5.5) BMI at baseline, mean (SD): 32.2 kg/m^2 (5.9) vs. 32.3 kg/m^2 (5.4) Race: NR	Ahokas Foundation, Finnish Foundation for Cardiovascular Disease, Special State Subsidy for Health Science Research of Helsinki University Central Hospital, Samfundet Folkhälsan, Finnish Diabetes Research Foundation, State Provincial Office of Southern Finland, Social Insurance Institution of Finland	Fair
Huvinen et al., 2018[112] *Note: f/u of Koivusalo et al., 2016	Same as Koivusalo et al., 2016	Same as Koivusalo et al., 2016	Same as Koivusalo et al., 2016	Same as Koivusalo et al., 2016	Same as Koivusalo et al., 2016	Same as Koivusalo et al., 2016	Same as Koivusalo et al., 2016	Same as Koivusalo et al., 2016	Same as Koivusalo et al., 2016	Same as Koivusalo et al., 2016

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Rono et al., 2018a[137] *Note: separate sample from Koivusalo et al., 2016, so considered a unique study	Same as Koivusalo et al., 2016	Same as Koivusalo et al., 2016	Same as Koivusalo et al., 2016	Same as Koivusalo et al., 2016	N=128 A. n=65 B. n=63	Same as Koivusalo et al., 2016 *Included specific to Rono 2018a: planning pregnancy within 1 year	1x every 3 months before pregnancy (time NR), three 2-hour sessions	RADIEL: prepregnancy sample A vs. B Age, mean (SD): 32 years (5) vs. 32 years (4) BMI baseline, mean (SD): 30.5 kg/m^2 (6.3) vs. 28.1 kg/m^2 (5.7), p<0.05 BMI obese: 52% vs. 33%, p<0.05 Prior GDM: 78% vs. 87% Nulliparous: 9% vs. 10%	Same as Koivusalo et al., 2016	Same as Koivusalo et al., 2016
Rono et al., 2018b[136] *Note: separate sample from Koivusalo et al., 2016, so considered a unique study	Same as Koivusalo et al., 2016	Same as Koivusalo et al., 2016	Same as Koivusalo et al., 2016	Same as Koivusalo et al., 2016	N=492 A. n=249 B. n=243	Same as Koivusalo et al., 2016 *Includes women <20 weeks' gestation *Not excluded if dx GDM <20 weeks' gestation	2 hour x3 sessions	RADIEL: normal + pathological OGTT sample A vs. B Age, mean (SD): 32.6 years (4.8) vs. 32.1 years (5) BMI baseline, mean (SD): 32.7 kg/m^2 (5.7) vs. 32.6 kg/m^2 (5.6) BMI obese: 73.5% vs. 74.9% Prior GDM: 40.6% vs. 40.3% Nulliparous: 38.3% vs. 39.1%	Same as Koivusalo et al., 2016	Same as Koivusalo et al., 2016

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Kunath et al., 2019[115] GeliS *Note: associated with Rauh et al., 2013	Cluster RCT	Gynecologic and midwifery practices Bavaria, Germany	Mixed	Counseling; Moderate intensity	N=2,261 A. n=1,139 B. n=1,122	Included: Singleton, BMI 18.5-40 kg/m^2, <12 weeks' gestation, aged 18-43 years, sufficient German language skills Excluded: Multiple or complicated pregnancy, severe preexisting illness	4 sessions (30-45 min each; 3 prenatal, 1 postpartum)	A vs. B Age, mean (SD): 30.2 years (4.4) vs. 30.4 years (4.7) BMI baseline, mean (SD): 24.4 kg/m^2 (4.4) vs. 24.3 kg/m^2 (4.6) BMI normal weight (<25 kg/m^2): 64.3% vs. 65.5% BMI overweight (25-29.9): 23.8% vs. 22.2% BMI obese (30-40): 11.9% vs. 12.3% Nulliparous: 62% vs. 53% Prior cesarean: 10.2% vs. 11.5%	Else Kroner-Fresenius Centre for Nutritional Medicine, Competence Centre for Nutrition, Bavarian State Ministry of Food, Agriculture, and Forestry, Bavarian State Ministry of Health and Care, AOK Bayem, DEDIPAC consortium	Fair
Hoffman et al., 2019[109] *Note: f/u of Kunath et al., 2019	Same as Kunath et al., 2019	Same as Kunath et al., 2019	Same as Kunath et al., 2019	Same as Kunath et al., 2019	N=1,998 A. n=1,003 B. n=995	Same as Kunath et al., 2019	Same as Kunath et al., 2019	A vs. B (for followup population) Age, mean (SD): 30.2 years (4.3) vs. 30.5 years (4.6) BMI baseline, mean (SD): 24.4 kg/m^2 (4.3) vs. 24.3 kg/m^2 (4.6) BMI normal weight (<25 kg/m^2): 64.3% vs. 65.5% BMI overweight (25-29.9): 24.2% vs. 21.9% BMI obese (30-40): 11.5% vs. 12.6% Primiparous: 61.8% vs. 53.2% Prior cesarean: 10.2% vs. 11.5%	Same as Kunath et al., 2019	Same as Kunath et al., 2019

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LeBlanc et al., 2020[116] PREPARE	RCT	Telephone and online, Oregon and Washington	Overweight and Obese	Counseling; High	N=326 A. n=164 B. n=162	Included: Ages 18-40 years; BMI ≥27 kg/m^2; not currently pregnant but planning pregnancy within 2 years; singleton pregnancies lasting ≥14 weeks (analytic cohort) Excluded: Conditions or on medications that would affect weight loss or study participation	30-40 min initial session, 20-30 min session weekly (6 months) and monthly (up to 18 months or until pregnancy end)	A vs. B Age, mean (SD): 31.6 years (3.5) vs. 30.9 years (3.5) Prepregnancy BMI: 34.9 kg/m2 (6) vs. 34.7 kg/m2 (5.5) BMI overweight (27-29.9): 21.4% vs. 22.5% BMI Class I obese (30-34.9): 38.2% vs. 38.8% BMI Class II obese (≥35): 40.5% vs. 38.8% Time from randomization to pregnancy (<6 months): 33.7% vs. 32.5% Time to pregnancy (6-24 months): 56.2% vs. 45% Time to pregnancy (>24 months): 10.1% vs. 22.5% BMI overweight at pregnancy onset: 30.7% vs. 26.2% BMI obese at pregnancy onset: 69.3% vs. 73.8% White: 80.9% vs. 87.5% Black: 5.6% vs. 2.5% Hispanic: 6.7% vs. 12.5%	NIDDK	Good

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Luoto et al., 2011[117] NELLI	RCT	Primary health care center-affiliated maternity clinics, 14 municipalities, Finland	Mixed	Counseling; Moderate intensity	N=442 A. n=246 B. n=196	Included: singleton pregnancy, 8-12 weeks' gestation, at least one of the following risk factors: BMI ≥25 kg/m^2; GDM or any signs of glucose intolerance or newborn's macrosomia (≥4,500 g) in any earlier pregnancy; T1D or T2D in first- or second-degree relatives; age ≥40 years Excluded: At least one abnormal oral glucose tolerance test among three baseline measurements; prepregnant T1D or T2D; inability to speak Finnish; age <18 years; multiple pregnancy; physical restriction preventing physical activity; substance abuse; treatment or clinical history of psychiatric illness	One 2-hour PA session; one dietary counseling session; 3-4 booster sessions	A vs. B Age, mean (SD): 29.5 years (4.8) vs. 30.0 years (4.7) Prepregnancy BMI: 26.3 kg/m^2 (4.9) vs. 26.4 kg/m^2 (4.3) BMI >25 kg/m^2: 58.4% vs. 61.5%	Finnish Diabetes research fund, Pirkanmaa hospital district, Academy of Finland, Ministry of Education, Ministry of Social Affairs and Health	Good
Kinnunen et al., 2012[113] *Note: f/u of Luoto et al., 2011	Same as Luoto et al., 2011	Same as Luoto et al., 2011	Same as Luoto et al., 2011	Same as Luoto et al., 2011	Same as Luoto et al., 2011	Same as Luoto et al., 2011	Same as Luoto et al., 2011	Same as Luoto et al., 2011	Same as Luoto et al., 2011	Same as Luoto et al., 2011
Magriples et al., 2015[118] Centering Pregnancy Plus	RCT	14 community health centers and hospitals, New York City, New York	Mixed	Counseling; Moderate intensity	N=984 A. n=495 B. n=489	Included: pregnant women aged 14-21 years attending prenatal care at a participating clinical site, <24 weeks gestation, no severe medical problems at time of enrollment, English or Spanish speaking, agreed to receive group prenatal care if offered at their site	10 sessions (120 mins each)	A vs. B Age, mean (SD): 18.7 years (1.8) vs. 18.6 years (1.7) BMI underweight: 11.7% vs. 11.5% BMI normal weight: 49.9% vs. 56.6% BMI overweight: 21.8% vs. 17.2% BMI obese: 16.6% vs. 14.7% Latina: 63.6% vs. 63.4% Black: 30.9% vs. 33.3% Other: 5.5% vs. 3.3%	NIH NIMH R01, Clinical Directors Network R01 One author founder of Centering Healthcare Institute and serves on Board of Directors	Fair

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McCarthy et al., 2016[119] FFF	RCT	One tertiary obstetric hospital, Melbourne, Australia	Overweight and obese	Counseling; Low intensity	N=382 A. n=190 B. n=192	Included: Overweight and obese (BMI ≥25.0), gestation <20 weeks, at least 18 years of age, singleton pregnancy, English speaking Excluded: Preexisting diabetes or known major fetal abnormality	30 mins x1 session	A vs. B Age, mean: 31.9 years vs. 31.8 years Pre/early pregnancy BMI, median: 30.5 kg/m^2 vs. 30.1 kg/m^2 BMI overweight (25-29.9 kg/m^2): 46.8% vs. 46.9% BMI Class I obese (30-34.9): 27.4% vs. 26.6% BMI Class II obese (35-39.9): 14.7% vs. 16.1% BMI Class III obese (≥40): 11.1% vs. 10.4% Country of birth, Australia: 77.4% vs. 74.0%	Medical Research Foundation for Women and Babies and the Mercy Research Foundation	Fair
McGiveron et al., 2015[120] Bumps and Beyond	CCT	One antenatal clinic, Lincolnshire, UK	Obese pregnant women	Counseling; Moderate intensity	N=178 A. n=89 B. n=89	Pregnant women with BMI ≥35 kg/m^2, gestational age 16-18 weeks	8 sessions	A vs. B Age, mean (SD): 29.0 years (5.8) vs. 27.3 years (5.5), p=0.04 BMI, mean: 39.4 kg/m^2 (4.1) vs. 38.4 kg/m^2 (3.2) White: 97% vs. 97%	Public Health Lincolnshire County Council	Fair

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Okesene-Gafa et al., 2019[121] HUMBA	RCT	University, home-based visits South Auckland, Australia	Obese	Counseling; High intensity	N=230 A. n=116 B. n=114	Included: Singleton, 12 to 17 0/6 weeks gestation, BMI ≥30 kg/m^2 Excluded: Preexisting diabetes, HbA1c ≥50 mmol/mol, known congenital abnormality, taking probiotics, prior bariatric surgery, severe hyperemesis, rx that alter glucose metabolism	4 sessions (1 at 1.5 hr, 3 at 30-60 min); text messages 3x per week	A vs. B (dietary intervention vs. usual care) Age, mean (SD): 29.8 years (5.7) vs. 27.8 years (5.5) BMI baseline, mean (SD): 39.2 kg/m^2 (6.2) vs. 37.9 kg/m^2 (5.9) BMI Class I obese (30-34.9 kg/m^2): 30.2% vs. 33.3% BMI Class II or higher (≥35): 69.8% vs. 66.7% Primiparous: 25.9% vs. 37.7% See Table 2 for racial/ethnic backgrounds; ~75% indigenous or Asian-Pacific Islander	Cure Kids, Lottery Health Research Grants, University of Auckland, Counties Manukau Health, Mercia Barnes Trust, Nurture Foundation, Heart Foundation	Good
Olson et al., 2018[122] e-Moms	RCT	Online, Rochester, New York	Mixed	Counseling; Moderate intensity	N=1,689 A. n=563 B. n=563 C. n=563	Included: Aged 18-35 years, gestational age <20 weeks, BMI 18.5-35 kg/m^2, with singleton pregnancies Excluded: BMI <18.5 and ≥35 kg/m^2, weight-affecting medical or psychiatric conditions, no email address	NR	A+B vs. C Age, 18-24.99 years: 32% vs. 30% Age, 25-29.99 years: 33% vs. 36% Age, 30-34.99 years: 36% vs. 34% BMI, median: 24.7 kg/m^2 vs. 24.7 kg/m^2 White: 64% vs. 65% Black: 24% vs. 21% Hispanic: 7% vs. 5% Other: 6% vs. 9%	NHLBI, National Institute of Child Health and Human Development	Fair

Appendix B Table 1. Included Studies – Study Characteristics

Author, Year Study Name	Study Design	Setting	Population BMI Category	Intervention Type; Intensity	Total N A=Intervention B=Control	Included and Excluded Criteria	Estimated Time	Population Characteristics A=Intervention B=Control	Funding Source	Quality Rating
Peccei et al., 2017[123]	RCT	One hospital-affiliated prenatal clinic, Revere, Massachusetts	Overweight and obese	Counseling; Moderate intensity	N=272 A. n=180 B. n=92	Included: Singleton pregnancy, BMI 25-40 kg/m^2, aged 18-49 years, <16 weeks' gestation Excluded: Multiple pregnancy, prepregnancy diabetes, history of eating disorders, miscarriage or abortion in early pregnancy	60-90 mins initial session, 10-30 mins 2x per month	A vs. B Age: NR BMI overweight: 42.2% vs. 43.5% BMI obese: 57.8% vs. 56.5% White: 36.1% vs. 45.7% Black: 7.8% vs. 3.3% Hispanic: 48.9% vs. 43.5% Other: 7.2% vs. 7.6%	Department of Obstetrics and Gynecology at Massachusetts General Hospital	Fair
Pelaez et al., 2019[124]	RCT	One university hospital, Madrid, Spain	Mixed	Active; High intensity	N=301 A. n=100 B. n=201	Included: Singleton, 8-10 weeks' gestation, uncomplicated, not participating in another exercise program, able to communicate in Spanish Excluded: Not planning to give birth at the hospital, contraindications to exercise	70-78 sessions (60-65 min 3x per week)	A vs. B Age, mean (SD): 31.1 years (3.2) vs. 31.5 years (4.7) BMI, mean (SD): 24.1 kg/m^2 (4.4) vs. 23.5 kg/m^2 (4) BMI underweight (<18.5 kg/m^2): 2% vs 6% BMI normal weight (18.5-24.9): 63% vs. 69.2% BMI overweight (25-29.9): 26% vs. 17.9% BMI obese (>30): 9% vs. 7% Smoker: 29% vs. 39.3%	Universidad Politécnica de Madrid	Fair
Perales et al., 2015[125]	RCT	One university hospital, Madrid, Spain	Overweight and obese	Active; High intensity	N=129 A. n=65 B. n=64	Included: Overweight and obese pregnant women without any complications, gestational age 8-11 weeks Excluded: NR	85 sessions (55-60 min)	A vs. B Age, mean (SD): 32.0 years (3.7) vs. 33.4 years (4) BMI, mean (SD): 27.9 kg/m^2 (3.1) vs. 28.0 kg/m^2 (2.6) Overweight: 80.8% vs. 83.3% Obese: 19.2% vs. 16.7% Race: NR	Universidad Politécnica de Madrid	Good

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Author, Year Study Name	Study Design	Setting	Population BMI Category	Intervention Type; Intensity	Total N A=Intervention B=Control	Included and Excluded Criteria	Estimated Time	Population Characteristics A=Intervention B=Control	Funding Source	Quality Rating
Petrella et al., 2014[126]	RCT	One hospital-based obstetrics unit, Modena, Italy	Overweight and obese	Counseling; Low intensity	N=63 A. n=33 B. n=30	Included: Pregnant women, aged >18 years, gestational age 12 weeks, singleton pregnancy, BMI ≥25 kg/m^2 Excluded: chronic diseases (i.e. diabetes mellitus, hypertension, untreated thyroid diseases), GDM in previous pregnancy, smoking during pregnancy, previous bariatric surgery, women who engaged in regular exercise activity, dietary supplements or herbal supplements known to affect body weight, other conditions that affect body weight	4 sessions (initial session 60 min; remainder time NR)	A vs. B Age, mean: 31.5 years (4.2) vs. 32.4 years (5.9) BMI, mean: 32.1 kg/m^2 (5) vs. 32.9 kg/m^2 (6.2) White: 85% vs. 67% Maghreb: 12% vs. 20% Other: 3% vs. 13%	NR	Fair
Phelan et al., 2011[128] Fit For Delivery	RCT	Six obstetrics offices, Providence, Rhode Island	Mixed	Counseling; Moderate intensity	N=401 A. n=201 B. n=200	Included: Pregnant women age >18 years, gestational age 10-16 weeks, BMI 19.8-40 kg/m^2, nonsmoking, with singleton pregnancy, fluency in English Excluded: self-reported major health psychiatric diseases, weight loss during pregnancy, or history of ≥3 miscarriages	One in-person session, three 10-15 min phone calls	A vs. B Age, mean (SD): 28.6 years (5.2) vs. 28.8 years (5.2) BMI, mean (SD): 26.3 kg/m^2 (5.6) vs. 26.5 kg/m^2 (5.9) White: 69% vs. 68% Hispanic: 20% vs. 20% Black: 7% vs. 10% Other: 5% vs. 3%	NIH	Fair
Phelan et al., 2014[127] *Note: f/u of Phelan et al., 2011	Same as Phelan et al., 2011	Same as Phelan et al., 2011	Same as Phelan et al., 2011	Same as Phelan et al., 2011	Same as Phelan et al., 2011	Same as Phelan et al., 2011	Same as Phelan et al., 2011	Same as Phelan et al., 2011	Same as Phelan et al., 2011	Same as Phelan et al., 2011

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Phelan et al., 2018[130] Healthy Beginnings / Comienzo Saludables	RCT	Two hospitals, San Luis Obispo, California and Providence, Rhode Island	Overweight and obese	Active; High intensity	N=264 A. n=132 B. n=132	Included: pregnant women aged ≥18 years, singleton, 9-16 weeks' gestation, BMI ≥25 kg/m^2, English or Spanish speaking Excluded: HbA1c ≥ 6.5, self-reported major health disease, current substance abuse, current tx for serious psychological disorder, hx of bariatric surgery, contraindications to exercise, not responsive during initial screening	Biweekly session (20 min) until 20 weeks' gestation, monthly session until delivery	A vs. B Age, mean (SD): 30.7 years (5.3) vs. 29.7 years (5.5) BMI baseline, mean (SD): 32.3 kg/m^2 (5.2) vs. 32.6 kg/m^2 (5.3) BMI overweight: 41.9% vs. 37.5% BMI obese: 58.1% vs. 62.5% White: 59.7% vs. 62.2% Hispanic: 41.1% vs. 42.2% Black: 6.2% vs. 5.4% AI/AN: 3.9% vs. 2.3% Native Hawaiian/PI: 2.3% vs. 2.3% Asian: 2.3% vs. 0.8% Primiparous: 29.9% vs. 24.6%	NIH (NHLBI)	Fair
Phelan et al., 2019[129] *Note: f/u to Phelan et al., 2018	Same as Phelan et al., 2018	Same as Phelan et al., 2018	Same as Phelan et al., 2018	Same as Phelan et al., 2018	Same as Phelan et al., 2018	Same as Phelan et al., 2018	Same as Phelan et al., 2018	Same as Phelan et al., 2018	Same as Phelan et al., 2018	Same as Phelan et al., 2018
Polley et al., 2002[131]	RCT	One obstetric clinic, Pittsburgh, Pennsylvania	Mixed	Counseling; Low intensity	N=120 A. n=61 B. n=59	Included: Aged ≥18 years, normal or overweight/obese, without a high-risk pregnancy, <20 weeks gestation Excluded: Previous complications during pregnancy, underweight women	NR	A vs. B Age, mean: 25.5 years (4.8) (pooled) Prepregnancy BMI, normal weight, mean (SD): 22.8 kg/m^2 (1.9) vs. 22.5 kg/m^2 (2.0) Prepregnancy BMI, overweight/obese, mean: 31.4 kg/m^2 (6.0) vs. 34.1 kg/m^2 (7.2) White: 61% (pooled) Black: 39% (pooled)	Magee Women's Health Foundation	Fair

Appendix B Table 1. Included Studies – Study Characteristics

Author, Year Study Name	Study Design	Setting	Population BMI Category	Intervention Type; Intensity	Total N A=Intervention B=Control	Included and Excluded Criteria	Estimated Time	Population Characteristics A=Intervention B=Control	Funding Source	Quality Rating
Rauh et al., 2013[132] FeLIPO	RCT	Eight gynecology practices, Munich, Germany	Mixed	Counseling; Low intensity	N=250 A. n=167 B. n=83	Included: Aged >18 years, singleton pregnancies, <18 weeks gestation, BMI ≥18.5 kg/m^2 Excluded: any condition preventing physical activity, T1D or T1D, uncontrolled chronic conditions	Two sessions (initial 60 min, second 30 min)	A vs. B Age, mean (SD): 32.2 years (4.4) vs. 30.8 years (4.9), p=0.01 Prepregnancy BMI, mean: 21.7 kg/m^2 vs. 22.8 kg/m^2, p=0.003 BMI normal weight: 84% vs. 69%; p=0.009 BMI overweight: 12% vs. 18% BMI obese: 4% vs. 13% Race: NR	Else Kroener-Fresenius Foundation	Fair
Rauh et al., 2015[133] *Note: f/u to Rauh et al., 2013	Same as Rauh et al., 2013	Same as Rauh et al., 2013	Same as Rauh et al., 2013	Same as Rauh et al., 2013	Same as Rauh et al., 2013	Same as Rauh et al., 2013	Same as Rauh et al., 2013	Same as Rauh et al., 2013	Same as Rauh et al., 2013	Same as Rauh et al., 2013
Redman et al., 2017[134] SmartMoms	RCT	Social media or community clinics, U.S.	Overweight and obese	Counseling; High intensity	N=54 A. n=18 B. n=19 C. n=17	Included: BMI 25-39.9 kg/m^2, aged 18-40 years, singleton pregnancy, first trimester Excluded: known fetal anomaly, HTN (systolic >160 / diastolic >90 mmHg), history or current psychotic or eating disorder, HIV, preexisting diabetes, or contraindications to exercise	18 lessons	A vs. B vs. C Age, mean (SD): 29.2 years (4.8) vs. 29 years (4.2) vs. 29 years (5.1) BMI overweight: 44% vs. 42% vs. 53% BMI obese: 56% vs. 58% vs. 47% White: 61% vs. 84% vs. 65% Black: 28% vs. 11% vs. 35% Other: 11% vs. 5% vs. 0%	NIH	Fair

Appendix B Table 1. Included Studies – Study Characteristics

Author, Year Study Name	Study Design	Setting	Population BMI Category	Intervention Type; Intensity	Total N A=Intervention B=Control	Included and Excluded Criteria	Estimated Time	Population Characteristics A=Intervention B=Control	Funding Source	Quality Rating
Renault et al., 2014[58] TOP	RCT	Hospital-based clinic, Copenhagen, Denmark	Obese	Counseling; High intensity	N=425 A. n=142 B. n=142 C. n=141	Included: aged >18, singleton pregnancy, normal scan 11-14 weeks' gestation, gestational age <16 weeks, able to read and speak Danish Excluded: multiple pregnancy, pregestational diabetes, other serious diseases limiting physical activity, previous bariatric surgery, alcohol or drug abuse	11-13 biweekly sessions	A vs. B vs. C Age, mean (SD): 31.2 years (4.2) vs. 30.9 years (4.9) vs. 31.3 years (4.2) Prepregnancy BMI, mean (SD): 34.4 kg/m^2 (4.2) vs. 34.1 kg/m^2 (4.4) vs. 33.7 kg/m^2 (3.5) White: 98% vs. 98% vs. 97%	Sygekassernes Helsefond and Broedrene Hartmann Fonden	Good
Ronnberg et al., 2014[135]	RCT	14 antenatal clinics, Örebro County, Sweden	Mixed	Counseling; Low intensity	N=445 A. n=221 B. n=224	Included: Pregnant women ≤16 weeks gestation, aged >18 years; singleton gestation, BMI >19 kg/m^2 Excluded: previous medical history including treatment of eating disorder or earlier growth-restricted infant, chronic disease that required specialized care, inadequate knowledge of Swedish language	1 session	A vs. B Age, mean (SD): 29.9 years (4.5) vs. 29.8 years (4.8) BMI, mean (SD): 25.2 kg/m^2 (4.9) vs. 25.3 kg/m^2 (4.8) BMI 19-26.0 kg/m^2: 72% vs. 71% BMI 26.1-29.0: 12% vs. 12% BMI >29: 16% vs. 17% Race: NR	Research committee at Oregbro County Council	Fair
Ruiz et al., 2013[138]	RCT	Three primary care medical centers, Madrid, Spain	Mixed	Active; High intensity	N=962 A. n=481 B. n=481	Included: Pregnant women at 5-6 weeks' gestation, singleton gestation, uncomplicated pregnancy, not at high risk of preterm delivery (no previous preterm delivery) Excluded: previous preterm delivery, women with any obstetrical contraindication to exercise	50-55 min exercise session 3x per week (planned 85 sessions)	A vs. B Age, mean (SD): 31.6 years (4) vs. 31.9 years (4) BMI, mean (SD): 23.7 kg/m^2 (3.9) vs. 23.5 kg/m^2 (4.2) BMI underweight (<18.5 kg/m^2): 2.3% vs. 5% BMI normal weight (18.5-24.9): 67.2% vs. 68.4% BMI overweight (25-29.9): 23.1% vs. 19.1% BMI obese (≥30): 7.3% vs. 7.7%	Grants from Spanish industry of science and innovation	Fair

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Author, Year Study Name	Study Design	Setting	Population BMI Category	Intervention Type; Intensity	Total N A=Intervention B=Control	Included and Excluded Criteria	Estimated Time	Population Characteristics A=Intervention B=Control	Funding Source	Quality Rating
Sagedal et al., 2017[139] Norwegian Fit For Delivery	RCT	Eight healthcare clinics, Norway	Mixed	Active; High intensity	N=606 A. n=303 B. n=303	Included: Nulliparous, ≥18 years old, singleton pregnancy, ≤20 weeks' gestation, prepregnancy BMI ≥19 kg/m^2, literate in Norwegian or English Excluded: Preexisting diabetes, disabilities precluding participation in a physical fitness program, continued substance abuse, planned relocation outside of study area before delivery	Two 20-min dietary counseling sessions, 60 mins recommended exercise sessions 2x per week	A vs. B Age, mean (SD): 27.9 years (4.2) vs. 28.1 years (4.5) Prepregnancy BMI, mean (SD): 23.8 kg/m^2 (4.1) vs. 23.5 kg/m^2 (3.7) BMI normal: 67.9% vs. 73.6% BMI overweight: 23.3% vs. 18.3% BMI obese: 8.1% vs. 7.1%	Norwegian South-Eastern Regional Health Authority, municipalities of Aust Agder and Vest Agder	Good
Sagedal et al., 2017b[140] *Note: f/u to Sagedal et al., 2017	Same as Sagedal et al., 2017	Same as Sagedal et al., 2017	Same as Sagedal et al., 2017	Same as Sagedal et al., 2017	Same as Sagedal et al., 2017	Same as Sagedal et al., 2017	Same as Sagedal et al., 2017	Same as Sagedal et al., 2017	Same as Sagedal et al., 2017	Same as Sagedal et al., 2017
Seneviratne et al., 2016[141]	RCT	Home-based supervised exercise Auckland, New Zealand	Overweight and obese	Active; High intensity	N=75 A. n=38 B. n=37	Included: Women aged 18-40 years, BMI ≥25 kg/m^2, singleton pregnancy, <20 weeks' gestation Excluded: Ongoing smoking, multiple pregnancy, contraindication to exercise, living outside Auckland region.	15-30 min exercise 3-5x per week (planned 67 sessions, from 20-35 weeks' gestation)	A vs. B Age, mean (SD): 31.6 years (4.6) vs. 31.1 years (5.2) BMI, mean (SD): 32.1 kg/m^2 (4.4) vs. 34.1 kg/m^2 (5.9) Nulliparous: 24% vs. 27% Pacific Islander: 29% vs. 29% Maori: 13% vs. 14% NZ European or other: 58% vs. 57%	Gravida National Centre for Growth and Development	Good

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Author, Year Study Name	Study Design	Setting	Population BMI Category	Intervention Type; Intensity	Total N A=Intervention B=Control	Included and Excluded Criteria	Estimated Time	Population Characteristics A=Intervention B=Control	Funding Source	Quality Rating
Simmons et al., 2017[142] DALI Lifestyle	RCT	Antenatal clinics across 11 centers in nine European countries (Austria, Belgium, Denmark, Ireland, Italy, Netherlands, Poland, Spain, UK)	Obese	Counseling; Moderate intensity	N=436 A. n=113 B. n=110 C. n=108 D. n=105	Included: pregnant women with prepregnancy BMI ≥29 kg/m^2 at ≤19 6/7 weeks gestation, singleton pregnancy, age ≥18 years Excluded: GDM, preexisting diabetes, chronic medical conditions, psychiatric disorders, inability to walk safely, requirement for complex diet, not fluent in major language of the country or unable to converse with language coach	5 in-person sessions (30-45 min); ≤4 telephone calls (≤20 min) or emails	A vs. B vs. C vs. D Age, mean (SD): 32.5 years (5.5) vs. 31.7 years (5.1) vs. 31.9 years (5.3) vs. 31.8 years (5.6) Prepregnancy BMI, mean (SD): 33.9 kg/m^2 (4.4) vs. 33.7 kg/m^2 (4.0) vs. 33.8 kg/m^2 (3.9) vs. 33.4 kg/m^2 (3.5) White: 84% vs. 86% vs. 88% vs. 90%	European Community's Seventh Framework Programme, Netherlands Organisation for health research, Odense University Free research fund, NIHR Clinical Research Network, CAIBER,	Good
Skouteris et al., 2016[143] HIPP	RCT	Two antenatal clinics, Melbourne, Australia	Mixed	Counseling; Moderate intensity	N=261 A. n=130 B. n=131	Included: Pregnant women age ≥18 years, with gestational age <18 weeks, English speaking, BMI >18.5 kg/m^2 Excluded: NR	Initial in-person session (60 min at 18 weeks), followup session (30 min at 24 weeks), 2 phone calls (15 min)	A vs. B Age, mean (SD): 31.4 years (4.4) vs. 31.6 years (4.5) BMI underweight (<18.5 kg/m^2): 4% vs. 4% BMI normal weight (18.5-24.9): 55% vs. 57% BMI overweight (25-29.9): 24% vs. 25% BMI obese (≥30): 17% vs. 14% Race: NR	National Health and Medical Research Council	Fair

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Author, Year Study Name	Study Design	Setting	Population BMI Category	Intervention Type; Intensity	Total N A=Intervention B=Control	Included and Excluded Criteria	Estimated Time	Population Characteristics A=Intervention B=Control	Funding Source	Quality Rating
Smith et al., 2016[144]	RCT	Online, U.S.	Mixed	Counseling; Moderate intensity	N=51 A. n=26 B. n=25	Included: Women with a history of participating in <3 sessions of exercise for ≥30 minutes per week for at least 6 months, aged 18 to 45 years, gestational age 10-14 weeks, speaking English, regular Internet access, and willing to walk 30 minutes on most days Excluded: History of gestational diabetes mellitus, preeclampsia, or chronic disease (e.g., T1D, heart disease, renal disease); BMI <18.5 kg/m^2; smoking during pregnancy; and having a condition or using a medication known to influence overall metabolism	1 in-person training session	A vs. B Age, mean (SD): 29.7 years (4.1) vs. 29.4 years (4.9) Prepregnancy BMI, mean (SD): 27.3 kg/m^2 (4.6) vs. 25.4 kg/m^2 (4.5) White: 88.9% (pooled)	American Heart Association predoctoral fellowship	Fair
Thomson et al., 2016[148] Delta Healthy Sprouts	RCT	Homes, Lower Delta region, Mississippi	Mixed	Counseling; High intensity	N=105 A. n=54 B. n=51	Included: ≥18 years of age, <19 weeks pregnant with 1st, 2nd, or 3rd child, resident of certain Mississippi counties, singleton fetus Excluded: NR	Monthly home visits (intervention 90-120 min; control 60-90 min)	A vs. B Age, mean (SD): 22.7 years (4.7) vs. 23.3 years (4.6) BMI underweight (<18.5 kg/m^2): 8% vs. 9% BMI normal weight (18.5-24.9): 21% vs. 28% BMI overweight (25-29.9): 26% vs. 21% BMI obese (≥30): 46% vs. 42% Black: 97% vs. 95% White: 3% vs. 5%	U.S. Department of Agriculture; Delta Health Alliance	Fair
Thomson et al., 2018[147] *Note: f/u of Thomson et al., 2016	Same as Thomson et al., 2016	Same as Thomson et al., 2016	Same as Thomson et al., 2016	Same as Thomson et al., 2016	N=54 A. n=24 B. n=30	Same as Thomson et al., 2016	18 monthly visits (gestational month 4 - postpartum month 12; 90-120 min)	A vs. B Age, mean (SD): 23 years (5) vs. 24.1 years (4.7) BMI, mean (SD): 29.2 kg/m^2 (7.7) vs. 28.6 kg/m^2 (8.2) Black: 95.8% vs. 96.7% White: 4.2% vs. 3.3%	Same as Thomson et al., 2016	Same as Thomson et al., 2016

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Author, Year Study Name	Study Design	Setting	Population BMI Category	Intervention Type; Intensity	Total N A=Intervention B=Control	Included and Excluded Criteria	Estimated Time	Population Characteristics A=Intervention B=Control	Funding Source	Quality Rating
Van Horn et al., 2018[149] MOMFIT	RCT	University hospital Chicago, Illinois	Overweight and obese	Counseling; High intensity	N=281 A. n=140 B. n=141	Included: pregnant women <16 weeks gestation, aged 18-45 years, singleton, BMI 25-40 kg/m^2, fluent in English, access to Internet and smartphone Excluded: preexisting diabetes, IVF, substance abuse, smoking, plans to terminate pregnancy or move out of area	3 individual visits (time NR), 9 telephone calls (time NR), six 30-min group sessions	A vs. B Age, mean (SD): 33 years (4) vs. 34 years (4) Prepregnancy BMI, mean (SD): 31 kg/m^2 (4) vs. 31 kg/m^2 (4) BMI obesity: 55% vs. 54.6% White: 54.4% vs. 70.2% Black: 24.3% vs. 14.2% Other: 19.3% vs. 15.6% Hispanic: 21.4% vs. 21.3% Nulliparous: 52.8% vs. 41.1%	NIH	Fair
Vesco et al., 2014[150] Healthy Moms	RCT	One managed care organization, Oregon and Washington	Obese	Counseling; High intensity	N=118 A. n=58 B. n=60	Included: Pregnant women aged ≥18 years, gestational weeks ≤21, BMI ≥30 kg/m^2 Excluded: diabetes mellitus, plans to leave the area within 1 year postpartum	2 individual sessions (time NR), 16 group sessions (90 min)	A vs. B Age, mean: 32.4 years (5.1) vs. 31.2 years (4.6) BMI, mean: 36.7 kg/m^2 (5.2) vs. 36.8 kg/m^2 (4.7) BMI Class I obese (30-34.9 kg/m^2): 45% vs. 43% BMI Class II obese (35-39.9): 34% vs. 36% BMI Class III obese (≥40): 21% vs. 21% White: 88% vs. 85%	National Institute of Child Health and Human Development	Good
Vesco et al., 2016[151] *Note: f/u of Vesco et al., 2014	Same as Vesco et al., 2014	Same as Vesco et al., 2014	Same as Vesco et al., 2014	Same as Vesco et al., 2014	Same as Vesco et al., 2014	Same as Vesco et al., 2014	Same as Vesco et al., 2014	Same as Vesco et al., 2014	Same as Vesco et al., 2014	Same as Vesco et al., 2014

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Author, Year Study Name	Study Design	Setting	Population BMI Category	Intervention Type; Intensity	Total N A=Intervention B=Control	Included and Excluded Criteria	Estimated Time	Population Characteristics A=Intervention B=Control	Funding Source	Quality Rating
Vinter et al., 2011[59] LiP	RCT	Two university hospitals, Denmark	Obese	Active; High intensity	N=360 A. n=180 B. n=180	Included: Women aged 18–40 years, 10–14 weeks' gestation, BMI 30–45 kg/m^2 (prepregnancy weight or first measured weight in pregnancy) Excluded: Prior obstetric complications, chronic diseases, positive OGTT in early pregnancy, alcohol or drug abuse, non-Danish speaking, multiple pregnancy	4 sessions	A vs. B Age, mean (IQR): 29 years (27-32) vs. 29 years (26-31) BMI, median (IQR): 33.4 kg/m^2 (31.7-36.5) vs. 33.3 kg/m^2 (31.7-36.9) BMI (30-34.9 kg/m^2): 63.3% vs. 66.2% BMI (35-39.9): 28.0% vs. 29.2% BMI (40-45): 8.7% vs. 4.6% White: 100%	Trygfonden, The Health Insurance Foundation (Helsefonden), the Faculty of Health Sciences, University of Southern Denmark, the Danish Diabetes Association, Odense University Hospital, the NoVo Foundation, the Danish Medical Association Research Foundation, Aase og Ejnar Danielsens Fond, CMA Medico, and Ferrosan A/S.	Fair
Vinter et al., 2014[152] *Note: f/u of Vinter et al., 2011	Same as Vinter et al., 2011	Same as Vinter et al., 2011	Same as Vinter et al., 2011	Same as Vinter et al., 2011	Same as Vinter et al., 2011	Same as Vinter et al., 2011	Same as Vinter et al., 2011	Same as Vinter et al., 2011	Same as Vinter et al., 2011	Same as Vinter et al., 2011
Tanvig et al., 2014[146] *Note: f/u of Vinter et al., 2011	Same as Vinter et al., 2011	Same as Vinter et al., 2011	Offspring of Vinter et al., 2011 sample	Same as Vinter et al., 2011	Same as Vinter et al., 2011	Same as Vinter et al., 2011	Same as Vinter et al., 2011	Same as Vinter et al., 2011	Same as Vinter et al., 2011	Same as Vinter et al., 2011

Appendix B Table 1. Included Studies – Study Characteristics

Author, Year Study Name	Study Design	Setting	Population BMI Category	Intervention Type; Intensity	Total N A=Intervention B=Control	Included and Excluded Criteria	Estimated Time	Population Characteristics A=Intervention B=Control	Funding Source	Quality Rating
Tanvig et al., 2015[145] *Note: f/u of Vinter et al., 2011	Same as Vinter et al., 2011	Same as Vinter et al., 2011	Offspring of Vinter et al., 2011 sample	Same as Vinter et al., 2011	Same as Vinter et al., 2011	Same as Vinter et al., 2011	Same as Vinter et al., 2011	Same as Vinter et al., 2011	Same as Vinter et al., 2011	Same as Vinter et al., 2011
Willcox et al., 2017[153] txt4two	RCT	Mobile devices, Melbourne, Australia	Overweight and obese	Counseling; High intensity	N=100 A. n=50 B. n=50	Included: singleton pregnancy, 10-17 6/7 weeks' gestation, prepregnancy BMI >25 kg/m^2, speak, read, write in English, own a mobile phone Excluded: multiple pregnancy, aged <18 years, comorbidities requiring significant medical dietary management, discontinuation of care at the hospital	15 min introduction meeting	A vs. B Age, mean (SD): 33 years (3.4) vs. 32 years (5.1) Prepregnancy BMI, mean (SD): 32.5 kg/m^2 (5.8) vs. 29.6 kg/m^2 (3.8) Birth country of Australia: 80% vs. 74%	Lord Mayors Charitable Foundation, Sidney Myer Health Scholarship, Queensland Health-Health Research Fellowship, National health and Medical Research Council Principal Research Fellowship	Fair
Wolff et al., 2008[154]	RCT	Two hospitals, Denmark	Obese	Counseling; Moderate intensity	N=50 A. n=23 B. n=27	Included: BMI ≥30 kg/m^2, mean gestational age 15 weeks Excluded: smoking, age below 18 or above 45 years, multiple pregnancy, medical complications known to affect fetal growth or contraindicated weight gain limitation	Ten 60-min sessions	A vs. B Age, mean (SD): 28 years (4) vs. 30 years (5) BMI, mean (SD): 34.9 kg/m^2 (4) vs. 34.6 kg/m^2 (3) Race: NR	Private foundation	Fair

Note: Low intensity = 0-2 contacts during intervention; Moderate intensity = 3-11 contacts during intervention; High intensity = 12 or more contacts during intervention.

Abbreviations: ACOG = American College of Obstetricians and Gynecologists; BMI = body mass index; CCT = controlled clinical trial; ESTEEM = Effect of Simple, Targeted Diet in Pregnant Women with Metabolic Risk Factors on Pregnancy Outcomes; ETIP = Exercise Training in Pregnancy; FPG = fasting plasma glucose; FPL = federal poverty level; GDM = gestational diabetes mellitus; GeliS = Gesund leben in der Schwangerschaft / Healthy Living in Pregnancy; HbA1c = hemoglobin A1c; HIV = human immunodeficiency virus; HTN = hypertension; HUMBA = Healthy Mums and Babies; IMD = Index of Multiple Deprivation; IQR = interquartile range; IVF = in vitro fertilization; LMP = lifestyle modification program; MMT = Mindful MAMAS Training; MOMFIT = Maternal Offspring Metabolics Family Intervention Trial; N = number; NR = not reported; OGTT = oral glucose tolerance test; OPTIMISE = not defined; PGL = plasma glucose level; POPS2 = Pregnancy Outcome Prediction Study; RCT = randomized controlled trial; SD = standard deviation; SES = socioeconomic status; SWEP = Study Water Exercise Pregnant; T1D or T2D = type 1 or type 2 diabetes; TOP = Treatment of Obese Pregnant Women.

Appendix B Table 2. Included Studies – Intervention Characteristics

Author, Year Study Name	Description Intervention + usual prenatal care Comparison	Special Training	Intervention Instruments
Aguilar-Cordero et al., 2019[71] SWEP	A. Intervention: supervised aquatic exercise classes from weeks 20 to 37. B. Comparison: usual prenatal care.	NR	EPDS (0-10, 0-9 no risk, 10-15 risk, 16+ severe risk); Borg Rating of Perceived Exertion scale
Al Wattar et al., 2019[72] ESTEEM	A. Intervention: in-person sessions; initial individual consultation with dietician, group sessions (20 weeks and 28 weeks), phone calls from team (24 weeks and 32 weeks). Provided mixed nuts (30 g/day walnuts, hazelnuts, almonds) and extra-virgin olive oil (0.5 L/week). Fact sheets on olive oil and mixed nuts, educational presentations, weekly individual food portion plan. B. Comparison: usual prenatal care.	Trained dietician, research team	ESTEEM recipe book; individual weekly food portion plan; IPAQ; EQ-5D; ESTEEM Q
Altazan et al., 2019[73] Expecting Success / SmartMoms *Note: associated with Redman, 2017	A. Intervention: in-person SmartMoms intervention, received dietary intake advice, exercise advice, weight graph created from dynamic GWG models to determine the trimester specific increase in energy intake required to adhere to the IOM recommendations. Structured intervention consisted of lessons and behavior modification counseling weekly (13-24 weeks), then biweekly (week 25 to delivery). B. Intervention: remote SmartMoms Intervention, same as above intervention, but delivered via intensity-matched phone app at least once weekly. C: Comparison: usual prenatal care.	Trained interventionists	Personalized IOM 2009 GWG graph; wireless internet-connected bathroom scale; pedometer; Beck Depression Inventory II (0-63, 0 better mood / no symptoms); Rand 12-Item Short Form for mental and physical health (0-100 each, 0 worse health / quality of life)
Althuizen et al., 2013[74] New Life(style)	A. Intervention: counseling modules on healthy lifestyle, personalized feedback on weight gain. B. Comparison: usual prenatal care.	Counselors with a background in physical activity or remedial education; trained on specific modules	Problem Solving Treatment for primary care method for counselors; IPAQ – Short Form; Dutch Nutrition Centre questionnaire; Accelerometer and Short Questionnaire to Assess Health enhancing physical activity (SQUASH); Dutch Eating Behaviour Questionnaire
Asbee et al., 2009[75]	A. Intervention: counseling on healthy lifestyle, recommended physical activity, personalized feedback on weight gain. B. Comparison: usual prenatal care	Registered dietician; training on lifestyle counseling	NR
Assaf-Balut et al., 2017[76]	A. Intervention: lifestyle guidance, emphasis on including healthy fats (olive oil and pistachio consumption). B. Comparison: usual prenatal care, emphasis on restricting fat.	Dietician	Diabetes Nutrition and Complications Trial questionnaire; Mediterranean Diet Adherence Screener
Bacchi et al., 2018[77]	A. Intervention: aerobic and aquatic exercises per ACOG guidelines. B. Comparison: usual prenatal care.	Qualified fitness specialist	Foam rubber balls; swimming accessories (e.g. floats); swimming mitts (for resistance); floating weights
Barakat et al., 2012[78]	A. Intervention: aerobic and aquatic exercise. B. Comparison: usual prenatal care.	Qualified fitness specialist, obstetrician	Heart rate monitor; barbells or resistance bands; swimming accessories; swimming mitts (for resistance)
Barakat et al., 2014[81]	A. Intervention: aerobic exercise. B. Comparison: usual prenatal care.	Qualified fitness specialist, obstetrician	NR
Barakat et al., 2016[80]	A. Intervention: aerobic exercise per ACOG guidelines. B. Comparison: usual prenatal care.	Qualified fitness specialist, obstetrician	Heart rate monitor; barbells or resistance bands

Appendix B Table 2. Included Studies – Intervention Characteristics

Author, Year Study Name	Description Intervention + usual prenatal care Comparison	Special Training	Intervention Instruments
Barakat et al., 2018[79]	A. Intervention: structured, supervised exercise classes from gestational week 9-11 to week 38-39. B. Comparison: usual prenatal care.	Qualified fitness specialist, obstetrician	Heart rate monitor; barbells; resistance bands; Decision Algorithm; Borg Rating of Perceived Exertion scale
Barakat et al., 2019[82]	A. Intervention: structured, supervised exercise classes from gestational week 8-10 to week 38-39; final motivational talk on importance of active pregnancy. B. Comparison: usual prenatal care.	Physical activity or sport science professional, obstetrician	Heart rate monitor; fitness equipment; Borg Rating of Perceived Exertion scale
Bogaerts et al., 2013[83]	A. Intervention A: motivational lifestyle intervention sessions and brochure about nutritional advice and physical activity during pregnancy, with information to limit excessive gestational weight gain. B. Intervention B: brochure only. C. Comparison: usual prenatal care.	Midwife trained in motivational lifestyle intervention	Spielberger State and Trait Anxiety Inventory; Edinburg Depression Scale; 7-day food diary
Brownfoot et al., 2016[84]	A. Intervention: weight recording at each prenatal visit with IOM guidelines prominently displayed; discussion with clinician about appropriate weight gain according to IOM guidelines. B. Comparison: usual prenatal care, did not have access to scales or weighing themselves as part of the visit.	None	IOM guidelines for healthy weight gain displayed in intervention rooms
Bruno et al., 2017[85]	A. Intervention: counselling session at enrollment with dietician for prescribed personalized dietary plan. B. Comparison: counselling session at enrollment with dietitian for general recommendations on diet and physical activity, given basic nutrition booklet, plus usual prenatal care.	Dietician	Food frequency questionnaire; standard dietary brochure; pedometer
Cahill et al., 2018[86] PreGO	A. Intervention: PAT+Lifestyle curriculum, including biweekly home visits by a parent educator with individualized counseling on diet and exercise, behavior change, reinforcement of lifestyle behaviors in postpartum period to return to baseline weight, plus parenting strategies and social support postpartum. B. Comparison: PAT curriculum, including biweekly home visits by a parent educator with parenting strategies and social support.	Trained parent educators	Parents as Teachers curriculum (a national home visiting organization curriculum)
Haire-Joshu et al., 2019[103]	A. Same as Cahill et al., 2018; plus monthly visits from delivery to 12 months postpartum. B. Same as Cahill et al., 2018; plus monthly visits from delivery to 12 months postpartum.	Same as Cahill et al., 2018	Same as Cahill et al., 2018
Claesson et al., 2010[87]	A. Intervention: motivational interviewing during extra visits to midwife on weight control and counseling weekly; invitation to aqua aerobics class semiweekly. B. Comparison: usual prenatal care.	Midwife	Beck Anxiety Inventory; Edinburgh Postnatal Depression Scale; Miller and Rollnick motivational interview guidelines
Daley et al., 2015[88]	A. Intervention: personalized feedback at each visit on weight gain, self-weighing, brief counseling on diet and exercise as needed based on weight gain. B. Comparison: usual prenatal care.	Midwife; 1 hour training course	IOM weight gain chart (specific to patient's prepregnancy BMI category); self-report weight chart

Appendix B Table 2. Included Studies – Intervention Characteristics

Author, Year Study Name	Description Intervention + usual prenatal care Comparison	Special Training	Intervention Instruments
Daley et al., 2019[89] POPS2	A. Intervention: personalized feedback at each visit on weight gain, self-weighing, brief counseling on diet and exercise as needed based on weight gain. B. Comparison: usual prenatal care.	Midwife; 1 hour training course	IOM weight gain chart (specific to patient's prepregnancy BMI category); self-report weight chart; HADS; Physical Activity in Pregnancy Questionnaire; Southampton Food Frequency Questionnaire
Daly et al., 2017[90] Healthy eating, Exercise and Lifestyle Trial	A. Intervention: participation in medically supervised exercise classes during pregnancy and up to 6 weeks postpartum; personal goal setting; Facebook group. B. Comparison: usual prenatal care.	Medically supervised exercise	ParMed-X form for assessing exercise contraindications; Facebook group for intervention participants; Borg Scale of Perceived Exertion
Dodd et al., 2014[56] LIMIT	A. Intervention: tailored dietary advice, recommendation for exercise, goal setting via in-person visits and phone calls. B. Comparison: usual prenatal care.	Research dietician	Workbook for goal setting
Dodd et al., 2018[91]	Same as Dodd et al., 2014	Same as Dodd et al., 2014	Same as Dodd et al., 2014
Dodd et al., 2019[92] OPTIMISE	A. Intervention: tailored dietary advice, recommendation for exercise, goal setting via in-person visits and phone calls. B. Comparison: usual prenatal care.	Research dietician	Recipe book and example menu plans; individual diet and PA plan; Harvard Semi-quantitative Food Frequency Questionnaire; SQUASH; SF12 Health Survey Questionnaire; Short Form Spielberger State Trait Inventory; EPDS
Epel et al., 2019[93] MMT	A. Intervention: Obesity-Related Behavioral Intervention Trials model, with sessions on mindful breathing, eating, and movement - nutritional and eating behavior, mindfulness-based eating awareness training, physical activity, and stress reduction. B. Comparison: treatment as usual group, comprised of women unable to attend group classes, or gestational age 20-23 weeks but otherwise would have been eligible for the intervention.	Two practitioners with graduate degrees (MA, CNM, PhD) with additional training in mindfulness and MB-EAT	Laminated cards with program components; reading assignments; curricula components based on Mindful Motherhood, MBSR, and MB-EAT; Cohen's Perceived Stress Scale; Patient Health Questionnaire; Pregnancy-Related Anxiety Scale; Acceptance and Action Questionnaire-II; Dutch Eating Behavior Questionnaire; Yale Food Addiction Scale; Stanford Brief Activity Survey
Gallagher et al., 2018[94] LIFT	A. Intervention: intensive counseling (individual and group) on behavior, nutrition, exercise; food and exercise logs; phone and email contact. B. Comparison: usual prenatal care, plus group education sessions on healthy lifestyle during pregnancy.	Nutritionist trained on nutritional needs of pregnant women	Intervention program modified from Diabetes Prevention Program and Action for Health in Diabetes (with focus on GWG control, not weight loss); 2010 Healthy Eating Index; PeaPod system; QMR nonimaging technique
Garnaes et al., 2016[97] ETIP	A. Intervention: supervised aerobic and strength exercise classes from gestational week 12-18 until delivery, recommended exercise at home, individualized IOM weight gain curve. B. Comparison: usual prenatal care.	Physical therapist	Calibrate electronic scale (Seca, Medema, Norway), measure blood pressure with CASMED 740 MAXNIBP, air displacement plethysmography (BOD POD, COSMED), assessed insulin with ELISA (IBL International) using a DS2 ELISA processing system (Dynex Technologies); IOM recommended weight gain curve; Borg Rating of Perceived Exertion scale
Garnaes et al., 2017[98]	Same as Garnaes et al., 2016	Same as Garnaes et al., 2016	Same as Garnaes et al., 2016
Garnaes et al., 2018[96]	Same as Garnaes et al., 2016	Same as Garnaes et al., 2016	Same as Garnaes et al., 2016

Appendix B Table 2. Included Studies – Intervention Characteristics

Author, Year Study Name	Description Intervention + usual prenatal care Comparison	Special Training	Intervention Instruments
Garneas et al., 2019[95]	Same as Garnaes et al., 2016; for intervention group, well-being questionnaire administered at baseline (gestational week 12-18), late pregnancy (34-37 weeks), and 3 months postpartum.	Same as Garnaes et al., 2016	Same as Garnaes et al., 2016; Psychological General Well-Being Index (0-110, with 110 being maximum positive wellbeing); EPDS (>10=depression); SF-36 Short Form Health Survey
Gesell et al., 2015[99] Madre Sana, Bebé Sano / Healthy Mother, Healthy Baby	A. Intervention: group intervention sessions (8-10 women plus facilitator) at community recreation center for healthy lifestyle intervention; also received infant injury prevention intervention. B. Comparison: home visits on infant injury prevention.	Curriculum developed by professional developer with input from focus group and community board; based on social learning theory, skills-based interventions	"A New Beginning" curriculum, portable stadiometer (Charder HM-200P Portstad)
Gray-Donald, et al., 2000[100]	A. Intervention: unclear; intervention based on social learning theory, administered by 2 nutritionists working with a team of health care workers, including a community nutritionist working in the Cree villages; frequency and type of contact not described. B. Comparison: no intervention.	Nutritionists; training in cultural beliefs concerning diet	Food Processor II (Version 5.3) and the 1992 Canadian Nutrient Database File (ESHA Research, Salem, Ore)
Guelfi et al., 2016[101]	A. Intervention: supervised home-based upright cycling, with progression to longer duration sessions depending on participant fitness. B. Comparison: usual prenatal care.	Exercise therapist	Borg Rating of Perceived Exertion scale; upright cycle ergometer; EPDS; DASS; SPAS; Exercise Habit Strength Questionnaire
Haakstad et al., 2011[102]	A. Intervention: supervised sessions of aerobic dance exercises for at least 12 weeks; weekly self-imposed physical activity. B. Comparison: usual prenatal care.	Certified aerobics instructors	Exercise program per AOCG guidelines; personal training diary
Harrison et al., 2013[104] HeLP-her	A. Intervention: behavior change lifestyle intervention based on Social Cognitive Theory, including individualized dietary and PA advice, goal setting, self-monitoring. B. Comparison: educational control on general Australian dietary and PA guidelines.	Health coach	NR
Harrison et al., 2014[105]	Same as Harrison et al., 2013	Same as Harrison et al., 2013	Same as Harrison et al., 2013
Hawkins et al., 2014[106] Estudio Vida	A. Intervention: Six-month lifestyle intervention tailored to Hispanic women, based on the Transtheoretical model and Social Cognitive Theory; telephone booster sessions. B. Comparison: usual prenatal care.	Three-session training course for facilitators, with booster education	Pregnancy Physical Activity Questionnaire
Herring et al., 2016[108]	A. Intervention: eHealth intervention based on the Social Ecological Model delivered over 12 weeks. B. Comparison: usual prenatal care.	NR	NR
Herring et al., 2017[107]	Same as Herring et al., 2016	Same as Herring et al., 2016	Same as Herring et al., 2016
Hui et al., 2012[110]	A. Intervention: exercise regimen (walking, mild-to-moderate aerobic, stretching and strength exercises), in groups and at home. Dietary interviews and counselling were provided twice to each participant in the intervention group by registered dietitians. B. Comparison: usual prenatal care.	Licensed fitness trainers, registered dieticians	Self-report exercise diary; Food Choice Map assessment

Appendix B Table 2. Included Studies – Intervention Characteristics

Author, Year Study Name	Description Intervention + usual prenatal care Comparison	Special Training	Intervention Instruments
Hui et al., 2014[111]	A. Intervention: community-based weekly exercise program, one-on-one private dietary consultation at baseline and 2 months later, used Food Choice Map software to assess dietary intake. B. Comparison: usual prenatal care.	NR	Food Choice Map software for dietary intake
Koivusalo et al., 2016[114] RADIEL	A. Intervention: structured, individualized lifestyle counseling, dietary advice, and PA program, plus initial group visit with dietician and usual care. Counseling from study nurse. For prepregnancy BMI ≥30 kg/m^2, recommended no weight gain during first two trimesters. B. Comparison: usual prenatal care, information leaflets on healthy diet and exercise.	Trained study nurses, dieticians	Food frequency questionnaire designed for study, including dietary index related to counseling topics; free access to local PA center; standard dietary brochure
Huvinen et al., 2018[112]	Same as Koivusalo et al., 2016	Same as Koivusalo et al., 2016	Same as Koivusalo et al., 2016
Rono et al., 2018a[137]	Same as Koivusalo et al., 2016. *Specific to Rono 2018a: prepregnancy recommendation for 5-10% weight loss prior to pregnancy for women BMI ≥25 kg/m^2.	Same as Koivusalo et al., 2016	Same as Koivusalo et al., 2016
Rono et al., 2018b[136]	Same as Koivusalo et al., 2016	Same as Koivusalo et al., 2016	Same as Koivusalo et al., 2016
Kunath et al., 2019[115] GeliS	A. Intervention: individual prenatal and postpartum in-person counseling sessions; counseling on self-monitoring weight gains based on IOM recommendations, healthy nutrition and balanced diet based on Healthy Start guidelines, recommended physical activity. B. Comparison: usual prenatal care, general information leaflets on healthy lifestyle in pregnancy.	Midwives, gynecologists, medical assistants	Presentation binder with counseling content and checklists; personalized IOM weight chart; list of local prenatal exercise programs; pedometer
Hoffman et al., 2019[109]	Same as Kunath et al., 2019	Same as Kunath et al., 2019	Same as Kunath et al., 2019
LeBlanc et al., 2020[116] PREPARE	A. Intervention: prepregnancy counseling focused on losing weight; dietary counseling using DASH plan without sodium restriction, physical activity counseling with daily goals of 60 min moderate-intensity activity and walking at least 10,000 steps; during pregnancy counseling focused on adhering to GWG guidelines, logging weight, food, and exercise into study website. B. Comparison: usual prenatal care, information on having a healthy pregnancy.	Health coach, trained behavioral interventionist	Dietary counseling using DASH plan without sodium restriction; project website
Luoto et al., 2011[117] NELLI	A. Intervention: physical activity counseling session, diet counseling session, physical activity boosters and diet boosters during visits, invitations to group meetings. B. Comparison: usual prenatal care.	Trained study nurses	Counseling cards (for nurses); notebooks (for participants); 181-item food frequency questionnaire (FFQ); baseline leisure-time physical activity; 15-D for quality of life; RAND-36 and Beck's depression scale; maternal and fetal anthropometric measures
Kinnunen et al., 2012[113]	Same as Luoto et al., 2011	Same as Luoto et al., 2011	Same as Luoto et al., 2011

Appendix B Table 2. Included Studies – Intervention Characteristics

Author, Year Study Name	Description Intervention + usual prenatal care Comparison	Special Training	Intervention Instruments
Magriples et al., 2015[118] Centering Pregnancy Plus	A. Intervention: group prenatal care, standard clinical intake, then groups of 8-12 women at same gestational age facilitated by 2 health providers, manualized curriculum. B. Comparison: usual prenatal care.	Health providers (physician or midwife) and an assistant	15-item version of Centers for Epidemiologic Study-Depression; 17-item Prenatal Distress Questionnaire, nutrition assessment with REAP (Rapid Eating Assessment for Patients); Physical activity with WAVE (weight, activity, variety, excess)
McCarthy et al., 2016[119] FFF	A. Intervention: Serial self-weighing and simple dietary advice. B. Comparison: usual prenatal care	Research midwife	Written questionnaires on frequency of weighing at home and during antenatal consultations; WHOQOL-BREF
McGiveron et al., 2015[120] Bumps and Beyond	A. Intervention: Bumps and Beyond intervention, including an educational booklet and one-on-one counseling sessions regarding diet, exercise, and healthy weight gain in pregnancy delivered approximately from 16 weeks until 6 weeks postpartum. B. Comparison: declined intervention.	Midwife or healthy lifestyle advisor	Booklet of intervention information
Okesene-Gafa et al., 2019[121] HUMBA	A. Intervention: individual, home-based education sessions including feedback on weight gain and SMARTER goals, HUMBA handbook with nutrition information, recipes, management of cravings, physical activity tips, motivational text messages worded as if from the baby regarding nutrition, plus probiotic or placebo capsules B. Comparison: usual prenatal care, NZ pamphlet on healthy eating and weight gain during pregnancy, plus probiotic or placebo capsules	Certified community health worker trained in Health Conversations; dietician	HUMBA handbook; personalized weight gain chart; probiotic or placebo capsules; FF-SF; PA-SF; STAI-SF; Short Form Health Survey; EPDS
Olson et al., 2018[122] e-Moms	A. Intervention: intervention website, including weight gain tracker, a diet and exercise goal-setting tool, and health information, accessed through 6 weeks postpartum. B. Intervention: intervention website, weight gain tracker, a diet and exercise goal-setting tool, and health information, accessed until delivery only. C. Comparison: control website, including only health information.	NA	Websites including weight gain tracker, a diet and exercise goal-setting tool, and health information,
Peccei et al., 2017[123]	A. Intervention: culturally appropriate, individualized meal plans and counseling on nutrition, exercise, reading food labels, shopping for food on a budget, and breastfeeding; weight tracking. B. Comparison: standard counseling on diet and exercise at randomization, and again at 6 weeks postpartum.	Study dietician	"Gaining Weight During Pregnancy" brochure developed for study; "Thumbs Up for Healthy Food Choices" booklet; nutrition and exercise questionnaire
Pelaez et al., 2019[124]	A. Intervention: structured, supervised exercise from weeks 12 to 36; 60-65 min sessions 3x per week (planned 70-78 sessions). B. Comparison: usual prenatal care.	Physical activity and sports science graduate student; midwife; obstetrician	Heart rate monitor, Borg Rating of Perceived Exertion Scale; barbells; elastic bands; fitball; exercise program per ACOG's guidelines
Perales et al., 2015[125]	A. Intervention: exercise sessions planned for a total of 85 sessions. B. Comparison: usual prenatal care.	Qualified fitness specialist	Center for Epidemiological Studies Depression scale; heart rate monitors; Borg's scale rate of perceived exertion; exercise program per ACOG's guidelines

Appendix B Table 2. Included Studies – Intervention Characteristics

Author, Year Study Name	Description Intervention + usual prenatal care Comparison	Special Training	Intervention Instruments
Petrella et al., 2014[126]	A. Intervention: Therapeutic Lifestyle Changes diet and exercise intervention, follow-up sessions to track adherence to program. B. Comparison: nutritional booklet, usual prenatal care.	Dietician and gynecologist	Pedometer
Phelan et al., 2011[128] Fit For Delivery	A. Intervention: in-person meeting plus phone calls following the Fit for Delivery behavioral intervention targeting diet and physical activity; women who were over or under guidelines received additional calls. B. Comparison: in-person meeting, usual prenatal care, study newsletters.	Dietician	NR
Phelan et al., 2014[127]	Same as Phelan et al., 2011	Same as Phelan et al., 2011	Same as Phelan et al., 2011
Phelan et al., 2018[130] Healthy Beginnings / Comienzo Saludables	A. Intervention: biweekly in-person sessions until 20 weeks' gestation, then monthly until delivery, on appropriate weight gain, physical activity, behavioral strategies for daily self-monitoring; partial meal replacement plan; goal setting for postnatal period. B. Comparison: usual prenatal care, plus initial welcome visit, study newsletters.	Dietitians or counselors with degrees in nutrition, community health, psychology, kinesiology, or a related field	Pedometer; body weight scales; study newsletters; meal replacement shakes and/or bars; Automated Self-Administered 24-Hour Recall website; Weight Control Strategies Scale
Phelan et al., 2019[129]	Same as Phelan et al., 2018	Same as Phelan et al., 2018	Same as Phelan et al., 2018
Polley et al., 2002[131]	A. Intervention: written information on targeting appropriate weight gain in pregnancy, exercise, and diet; newsletters; personalized graph of weight gain; stepped care for with more structure for goals if weight exceeded recommendations; check-in phone calls. B. Comparison: usual prenatal care.	Master's and doctoral-level staff with training in nutrition or clinical psychology	Block Food Frequency Questionnaire; Paffenbager Exercise Questionnaire
Rauh et al., 2013[132] FeLIPO	A. Intervention: individual counseling module intervention targeting healthy lifestyle information, self-monitoring of diet and physical activity, self-monitoring of weight gain, and setting personal behavioral goals. B. Comparison: usual prenatal care.	Trained researchers	7-day dietary records; OptiDiet software; IPAQ
Rauh et al., 2015[133]	Same as Rauh et al., 2013	Same as Rauh et al., 2013	Same as Rauh et al., 2013
Redman et al., 2017[134] SmartMoms	A. Intervention: in-person SmartMoms intervention, received dietary intake advice, exercise advice, weight graph for trimester-specific increase in energy intake for adherence to IOM recommendation. Structured intervention consisted of lessons and behavior modification counseling weekly (13-24 weeks), then biweekly (week 25 to delivery). B. Intervention: remote SmartMoms Intervention, same as above intervention, but delivered via intensity-matched phone app. C. Comparison: usual prenatal care.	Trained interventionists	Wireless bathroom scale and pedometer; Fitbit Zip

Appendix B Table 2. Included Studies – Intervention Characteristics

Author, Year Study Name	Description Intervention + usual prenatal care Comparison	Special Training	Intervention Instruments
Renault et al., 2014[58] TOP	A. Intervention: PA plus D (physical activity and dietary intervention), with followup on dietary advice and encouragement to increase physical activity as assessed by pedometer. B. Intervention: PA (physical activity) only, encouraged to increase physical activity as assessed by pedometer. C. Comparison: usual prenatal care.	Dietician	Pedometer
Ronnberg et al., 2014[135]	A. Intervention: individual education on IOM guidelines for recommended GWG by BMI category, personalized graph to monitor with midwife, weight discussed at each visit, formalized prescription of PA (recommended daily moderate PA). B. Comparison: usual prenatal care.	Midwives	NR
Ruiz et al., 2013[138]	A. Intervention: structured, supervised, light-to-moderate intensity exercise intervention program from week 9 to weeks 38/39. A mean of 85 training sessions were planned for each participant in the event of no preterm delivery. B. Comparison: usual prenatal care.	Supervised exercise	Heart rate monitors; Borg conventional 6-20 point scale for the rate of perceived exertion; resistance equipment (barbells, elastic Thera bands)
Sagedal et al., 2017[139] Norwegian Fit For Delivery	A. Intervention: dietary counseling sessions on awareness of food choices, access to exercise classes, lifestyle recommendations from booklets and trial website, cooking class. B. Comparison: usual prenatal care.	Physical therapists or trained sports science students; clinical dieticians or trained public health graduate students	Ten recommendations to increase awareness of food choices; trial internet site; booklet on nutrition and PA; diet questionnaire corresponding to specific trial recommendations; IPAQ – Short Form
Sagedal et al., 2017b[140]	Same as Sagedal et al., 2017	Same as Sagedal et al., 2017	Same as Sagedal et al., 2017
Seneviratne et al., 2016[141]	A. Intervention: written program prescribing frequency and duration of weekly moderate-intensity exercise using magnetic stationary bicycle. B. Comparison: usual prenatal care.	Exercise physiologist	Heart rate monitor; stationary bicycle; Pregnancy Physical Activity Questionnaire; Foodworks software; WHO QUOL-BREF
Simmons et al., 2017[142] DALI Lifestyle	A. Intervention A: assigned healthy eating (HE) lifestyle coach, individual sessions on 7 messages promoting healthy eating, study toolkit. B. Intervention B: assigned physical activity (PA) lifestyle coach, 5 messages promoting aerobic and resistance PA, study toolkit. C. Intervention C: HE and PA interventions combined. D. Comparison: usual prenatal care.	Coaches trained on intervention	Pregnancy Physical Activity Questionnaire; short food frequency questionnaire
Skouteris et al., 2016[143] HIPP	A. Intervention: individual health coaching intervention, telephone followup sessions, and educational group sessions. B. Comparison: education group session for control.	Trained health coaches	Readiness to change questionnaire; Edinburgh Postnatal Depression Scale; Depression, Anxiety, and Stress Scale; Ben-Tovim Walker Body Attitudes Questionnaire; COPE; Pittsburgh Sleep Quality Index

Appendix B Table 2. Included Studies – Intervention Characteristics

Author, Year Study Name	Description Intervention + usual prenatal care Comparison	Special Training	Intervention Instruments
Smith et al., 2016[144]	A. Intervention: web-based behavioral intervention including exercise goal-setting modules, problem-solving modules, journal, calendar to track all exercise until delivery, community forum to interact with other participants in the intervention. B. Comparison: usual prenatal care, plus access to the website's general pages with information on recommended PA and weight gain during pregnancy.	No	3-day food diary
Thomson et al., 2016[148] Delta Healthy Sprouts	A. Intervention (PATE): home visits using PAT curriculum plus culturally tailored maternal weight management and early childhood obesity prevention components. Based on DPP and inFANT trial, with emphasis placed on healthy eating and weight control during pregnancy. B. Comparison (PAT): home visits using PAT curriculum, monthly group meetings, developmental screenings, and a resource network for families.	Trained parent educators, PhD-level master trainers	Digital scale (model SR241, SR Instruments), maternal weight loss charts, infant growth charts, instructional DVDs, hands-on activities, Nutrition Data System for Research software, Parents as Teachers curriculum
Thomson et al., 2018[147]	Same as Thomson et al., 2016	Same as Thomson et al., 2016	Same as Thomson et al., 2016
Van Horn et al., 2018[149] MOMFIT	A. Intervention: education on MAMA-DASH diet (modified DASH diet for pregnancy), food intake tracking, PA guidelines, individual emails, text messages, and phone calls using motivational interviewing from registered dietician nurse, emails with educational materials and resources, MOMFIT website, group sessions on lifestyle and breastfeeding. B. Comparison: usual prenatal care, access to MOMFIT website with general dietary and pregnancy care information.	Registered dietician nutritionist, certified lactation consultant	LOSEIT! App; pedometer or smartphone tracking device; MOMFIT website; Automated Self-Administered 24-Hour Recall website; SF-12; BDI-II
Vesco et al., 2014[150] Healthy Moms	A. Intervention: individual counseling session, group sessions, diet and exercise intervention, with diet based on DASH and recommended daily moderate PA. B. Comparison: usual prenatal care, with a single general health education session as control.	Dieticians	Diaries to track diet and physical activity, and chart weight
Vesco et al., 2016[151]	Same as Vesco et al., 2014	Same as Vesco et al., 2014	Same as Vesco et al., 2014
Vinter et al., 2011[59] LiP	A. Intervention: dietary counseling at 15, 20, 28, and 35 weeks' gestation, recommended daily moderate PA, pedometer, free full-time membership in a fitness center for 6 months, closed individual and group training classes with physiotherapists. B. Comparison: access to a website with general advice about dietary habits and PA in pregnancy.	Trained dieticians, physiotherapists	None
Vinter et al., 2014[152]	Same as Vinter et al., 2011	Same as Vinter et al., 2011	Same as Vinter et al., 2011
Tanvig et al., 2014[146]	Same as Vinter et al., 2011	Physician, research bioanalyst	DEXA scan (Lunar Prodigy Scanner)
Tanvig et al., 2015[145]	Same as Vinter et al., 2011	Same as Tanvig et al., 2014	Same as Tanvig et al., 2014

Appendix B Table 2. Included Studies – Intervention Characteristics

Author, Year Study Name	Description Intervention + usual prenatal care Comparison	Special Training	Intervention Instruments
Willcox et al., 2017[153] txt4two	A. Intervention: multimodal, including face-to-face introduction, text messages, website, video messages, chat room interaction, all informed by Social Cognitive Theory and CALO-RE taxonomy of behavior changes, emphasize daily moderate PA. B. Comparison: usual prenatal care.	Trained researcher, obstetrician, dietician, physiotherapist	Study booklet; tailored text messages based on behavior change theories; study-specific website; study videos; private study Facebook page; standard usual care brochure; food frequency questionnaire; Pregnancy Physical Activity Questionnaire
Wolff et al., 2008[154]	A. Intervention: in-person visits with nutritionist on eating a healthy diet; given energy restricted diet plan. B. Comparison: usual prenatal care.	Dietician	7-day food records

Abbreviations: ACOG = American College of Obstetricians and Gynecologists; BDI-II = Beck Depression Inventory II; BMI = body mass index; CALO-RE = Coventry, Aberdeen, and London – Refined; COPE = COPE scale; DASH = Dietary Approaches to Stop Hypertension; DASS = Depression Anxiety Stress Scale; DPP = Diabetes Prevention Program; EPDS = Edinburgh Postnatal Depression Scale; EQ-5D = EuroQol 5D; ESTEEM = Effect of Simple, Targeted Diet in Pregnant Women with Metabolic Risk Factors on Pregnancy Outcomes; ETIP = Exercise Training in Pregnancy; FFQ = Food Frequency Questionnaire; GWG = gestational weight gain; HE = healthy eating; HUMBA = Healthy Mums and Babies; inFANT = Infant Feeding Activity and Nutrition Trial; IOM = Institute of Medicine; IPAQ = International Physical Activity Questionnaire; IVF = in vitro fertilization; LIFT= Lifestyle Interventions For Two; MAMA-DASH = modified DASH diet for pregnancy; MB-EAT = Mindfulness-based Eating Awareness Training; MBSR = Mindfulness-based Stress Reduction; MMT = Mindful MAMAS Training; MOMFIT = Maternal Offspring Metabolics Family Intervention Trial; NR= not reported; OPTIMISE = not defined; PA= physical activity; PAT = Parents As Teachers; PATE = Parents As Teachers Enhanced; POPS2 = Pregnancy Outcome Prediction Study; QMR = quantitative magnetic resonance; SPAS = Social Physique Anxiety Scale; SQUASH = Short Questionnaire to Assess Health-enhancing physical activity; STAI-SF = State Trait Anxiety Inventory-Short Form; SWEP = Study Water Exercise Pregnant; TOP = Treatment of Obese Pregnant Women; WHOQOL-BREF = World Health Organization Quality of Life abbreviated scale.

Appendix B Table 3. Included Studies – Outcomes and Harms

Author, Year Study Name	Weight Assessment Timepoint	Outcomes (Key Question 1)* A=Intervention B=Control	Outcomes (Key Question 2) A=Intervention B=Control	Outcomes (Key Question 3) A=Intervention B=Control	Adherence
Aguilar-Cordero et al., 2019[71] SWEP	36-Delivery	NR	A vs. B Maternal GWG, mean: 8.3 kg vs. 11.2 kg, p=NR	A vs. B Maternal EPDS score (4-6 weeks postpartum), mean (SD): 6.41 (3.7) vs. 10.2 (2.4), p<0.001 EPDS score ≥10: 21.5% vs. 59.4% p<0.001 EPDS score, normal BMI, mean (SD): 5.63 (3.4) vs. 8.36 (2.3), p=0.047 EPDS score, overweight BMI, mean (SD): 3.13 (4.1) vs. 10.23 (2.4), p<0.001 EPDS score, obese BMI, mean (SD): 7.88 (3.0) vs. 11.00 (1.9), p=0.001	>80%

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Author, Year Study Name	Weight Assessment Timepoint	Outcomes (Key Question 1)* A=Intervention B=Control	Outcomes (Key Question 2) A=Intervention B=Control	Outcomes (Key Question 3) A=Intervention B=Control	Adherence
Al Wattar et al., 2019[72] ESTEEM	36-Delivery	A vs. B Maternal Antepartum hemorrhage (not defined): 1.6% (9/548) vs. 2.2% (13/580), aOR 0.70, 95% CI, 0.29 to 1.72, p=0.44 Infant NICU: 9.2% (49/533) vs. 11.3% (64/565), aOR 0.79, 95% CI, 0.53 to 1.18, p=0.25 Stillbirth: 0.2% (1/533) vs. 0.4% (2/566), aOR 0.49, 95% CI, 0.04 to 5.57, p=0.56 Neonatal death: 0.6% (3/532) vs. 0.2% (1/566), aOR 3.93, 95% CI, 0.33 to 46.10, p=0.28	A vs. B Maternal GWG, mean (SD): 6.8 kg (5.6) vs. 8.3 kg (6.4), aMD -1.2, 95% CI, -2.2 to -0.2, p=0.03 GDM: 17.6% (84/477) vs. 24.9% (124/497), aOR 0.65, 95% CI, 0.47 to 0.91, p=0.01 Preeclampsia: 6.2% (34/552) vs. 4.6% (27/585), aOR 1.43, 95% CI, 0.84 to 2.43, p=0.19 Cesarean (not defined): 32.6% (175/539) vs. 30.8% (176/571), aOR 1.06, 95% CI, 0.8 to 1.37, p=0.65 Composite maternal outcome (GDM or PreE): 22.8% vs. 28.6%, aOR 0.76, 95% CI, 0.56 to 1.03, p=0.08 ESTEEM Q score, mean (SD) [higher=better diet]: 7.2 (2.0) vs. 5.1 (2.0), aOR 2.0, 95% CI, 1.7 to 2.3, p<0.001 See Table 5 for obese vs. not obese on outcomes; p=NS for all Infant LGA (>90th percentile): 11.1% (59/531) vs. 10.8% (61/564); aOR 1.01, 95% CI, 0.69 to 1.49, p=0.94 Preterm birth (<37 weeks): 9.5% (52/545) vs. 11.1% (64/579); aOR 0.82, 95% CI, 0.55 to 1.22, p=0.33 Preterm birth (<34 weeks): 4.2% (23/545) vs. 4.5% (26/579); aOR 0.92, 95% CI, 0.51 to 1.67, p=0.79 Composite offspring outcome (stillbirth, SGA, or NICU): 17.3% vs. 20.9%; aOR 0.79, 95% CI, 0.58 to 1.08, p=0.14	No SAEs related to intervention A vs. B SGA: 9.8% (52/531) vs. 12.2% (69/564); aOR 0.78, 95% CI, 0.53 to 1.15, p=0.21	74% attended at least one session.
Altazan et al., 2019[73] Expecting Success / SmartMoms *Note: associated with Redman, 2017	34-36	NR	A vs. B GWG, least squares men (SE): 8.7 kg (0.9) vs. 12.8 kg (1.5), p=0.03 Excess GWG: 56.3% (18/32) vs. 81.8% (9/11), p=0.17	NR	NR

Appendix B Table 3. Included Studies – Outcomes and Harms

Author, Year Study Name	Weight Assessment Timepoint	Outcomes (Key Question 1)* A=Intervention B=Control	Outcomes (Key Question 2) A=Intervention B=Control	Outcomes (Key Question 3) A=Intervention B=Control	Adherence
Althuizen et al., 2013[74] New Life(style)	34-36	NR	A vs. B, all p>0.05 Maternal GWG, mean (SD): 11.6 kg (4.1) vs. 11.1 kg (3.2); MD -0.05 kg, 95% CI, -1.1 to 1.0 Excess GWG: 70.4% vs. 72.4%; OR 0.92, 95% CI, 0.48 to 1.77 PPWR, mean (SD): -0.53 kg (5.5) vs. -1.75 kg (5.1); MD 0.94, 95% CI, -2.41 to 0.53 Cesarean: 16% vs. 21%; OR 0.60, 95% CI, 0.29 to 1.25 Infant Macrosomia: 19% vs. 14%; OR 1.6, 95% CI, 0.76 to 3.41 Preterm birth (<37 weeks): 6% vs. 7%; OR 0.94, 95% CI, 0.27 to 3.35	NR	83% of women attended all sessions. Intervention dose was moderate (45.8-60.3%), and dose of Problem Solving Treatment for primary care principles was low (17.3%); see p. 94.
Asbee et al., 2009[75]	Delivery	NR	A vs. B Maternal GWG, mean (SD): 13.0 kg (5.7) vs. 16.1 kg (7.0), p=0.01 GWG, parous vs. nulliparous, mean (SD): 12.6 kg (5.8) vs. 16.6 kg (6.6), p<0.01 GWG within recommendations, parous vs. nulliparous: OR 6.2, 95% CI, 1.6 to 24.1, p=0.008 Excess GWG: 38.6% vs. 51.2%, p>0.05 Excess GWG by BMI <26 kg/m^2: 20% vs. 32%, p>0.05 Excess GWG by BMI 26-29 kg/m^2: 70% vs. 75%, p>0.05 Excess GWG by BMI >29 kg/m^2: 66.7% vs. 80%, p>0.05 Cesarean: 14.0% vs. 27.9%, p>0.05	NR	NR

Appendix B Table 3. Included Studies – Outcomes and Harms

Author, Year Study Name	Weight Assessment Timepoint	Outcomes (Key Question 1)* A=Intervention B=Control	Outcomes (Key Question 2) A=Intervention B=Control	Outcomes (Key Question 3) A=Intervention B=Control	Adherence
Assaf-Balut et al., 2017[76]	36-Delivery	A vs. B Maternal Perineal trauma: 3.2% vs. 10.9%, p=0.001; RR 0.21, 95% CI, 0.12 to 0.36, p=0.001 Infant RDS: 0.7% vs. 0.9%, p>0.05 Shoulder dystocia: 0% vs. 0.2% NICU: 1.8% vs. 3.2%, p>0.05	A vs. B Maternal GWG, mean (SD): 9.9 kg (4.7) vs. 9.4 kg (4.3), p>0.05 GWG by BMI <25 kg/m^2, mean (SD): 10.6 kg (4.0) vs. 9.9 kg (3.9), p>0.05 GWG by BMI 25-29.9 kg/m^2, mean (SD): 8.3 kg (6.5) vs. 8.8 kg (4.5), p>0.05 GWG by BMI ≥30 kg/m^2, mean (SD): 7.2 kg (4.7) vs. 5.6 kg (5.6), p>0.05 GDM: 17.1% vs. 23.4%, p=0.01; RR 0.73, 95% CI, 0.56 to 0.97, p=0.02 HTN: 3.0% vs. 4.3%, p>0.05 Preeclampsia: 1.6% vs. 2.5%, p>0.05 Cesarean, elective: 13.8% vs. 13.6%, p>0.05 Cesarean, emergency: 15% vs. 51.7%, p=0.001; RR 0.30, 95% CI, 0.14 to 0.63, p=0.001 Infant Macrosomia: 0% vs. 0.5% LGA: 0.9% vs. 4.1%, p=0.002; RR 0.19, 95% CI, 0.07 to 0.57, p=0.003 Preterm birth (<37 weeks): 1.2% vs. 3.8%, p=0.009; RR 0.29, 95% CI, 0.11 to 0.77, p=0.01	A vs. B SGA: 1.2% vs. 5.7%, p=0.001; RR 0.21, 95% CI, 0.08 to 0.54, p=0.001	Nutrition score and Med Diet score improved significantly, both between groups and within groups, as study continued.
Bacchi et al., 2018[77]	36-Delivery	NR	A vs. B Maternal GWG, mean (SD): 12.7 kg (2.6) vs. 13.9 kg (4.3), p>0.05 Excess GWG: 24.5% vs. 45.2%, p=0.02; OR 0.39, 95% CI, 0.17 to 0.89 Excess GWG by BMI underweight: 10% vs. 20% Excess GWG by BMI normal weight: 15.2% vs. 27.7% Excess GWG by BMI overweight: 55.6% vs. 52.6% Excess GWG by BMI obese: 44% vs. 51.7% p=0.01 for all excess GWG BMI categories Infant Macrosomia: 8.2% vs. 14.5%, p>0.05 Preterm birth (<37 weeks): 4.1% vs. 4.8%, p>0.05	A vs. B Low birth weight (<2,500 g): 2% vs. 3.2%, p>0.05	>85%
Barakat et al., 2012[78]	36-Delivery	NR	A vs. B, all p>0.05 Maternal GWG, mean (SD): 12.5 kg (3.2) vs. 13.8 kg (3.1) GDM (at least two abnormal tests): 0% vs. 7% Cesarean: 30% vs. 14%	NR	85%

Appendix B Table 3. Included Studies – Outcomes and Harms

Author, Year Study Name	Weight Assessment Timepoint	Outcomes (Key Question 1)* A=Intervention B=Control	Outcomes (Key Question 2) A=Intervention B=Control	Outcomes (Key Question 3) A=Intervention B=Control	Adherence
Barakat et al., 2014[81]	Delivery	NR	A vs. B, all p>0.05 unless noted Maternal GWG, mean (SD): 11.72 kg (4.06) vs. 13.66 kg (9.62) Excess GWG: 21.2% vs. 35.6%, p=0.02 GDM: 4.7% vs. 5.6% Caesarean: 17.1% vs. 28.6% Infant Preterm birth (<37 weeks): 3.8% vs. 4.4%	NR	94% (128/137) in the intervention group received the intervention.
Barakat et al., 2016[80]	36-Delivery	NR	A vs. B Maternal GWG, mean (SD): 12.1 kg (3.7) vs. 12.9 kg (4.5), p=0.01 Excess GWG: 26.4% vs. 34.2%, p=0.03; OR 1.47, 95% CI, 1.06 to 2.03, p=0.02 GDM: 2.4% vs. 5.5%, p=0.03; OR 2.05, 95% CI, 0.91 to 4.6, p>0.05 HTN: 2.1% vs. 5.7%, p=0.009; OR 2.96, 95% CI, 1.29 to 6.81, p=0.01 Preeclampsia: 0.5% vs. 2.3%, p=0.03 Cesarean: 19.1% vs. 21.7%, p>0.05 Infant Macrosomia: 1.8% vs. 4.7%, p=0.03; OR: 2.53, 95% CI, 1.03 to 6.20, p=0.04 Preterm birth (<37 weeks): 7.6% vs. 9.7%; OR 1.31, 95% CI, 0.78 to 2.19, p>0.05	A vs. B Low birth weight (<2,500 g): 4.2% vs. 6.5%; OR 1.6, 95% CI, 0.83 to 3.09, p>0.05	≥80%
Barakat et al., 2018[79]	36-Delivery	NR	A vs. B Maternal GWG, mean (SD): 12.3 kg (3.6) vs. 13.3 kg (4.1), p=0.015 Excess GWG: 20.7% (47/227) vs. 30.2% (61/202), p=0.02 Infant Macrosomia (>4 kg): 3.5% (8/227) vs. 6.9% (14/202) Preterm birth (<37 weeks): 4.4% (10/227) vs. 3.5% (7/202)	NR	>80%
Barakat et al., 2019[82]	36-Delivery	NR	A vs. B Maternal GWG, mean (SD): 12.2 kg (3.7) vs. 13.3 kg (4.1), p=0.005 Excess GWG: 20.5% (48/234) vs. 30.2% (67/222); OR 0.60, 95% CI, 0.39 to 0.92, p=0.02 GDM: 2.6% (6/234) vs. 6.8% (15/222); OR 0.36, 95% CI, 0.14 to 0.95, p=0.03 Cesarean (not defined): 20.5% (48/234) vs. 20.7% (46/222), p=0.41 Infant Macrosomia: 3.4% (8/234) vs. 7.2% (16/222); OR 0.46, 95% CI, 0.19 to 1.09, p=0.07 Preterm birth (<37 weeks): 4.3% (10/234) vs. 3.2% (7/222), p=0.53	NR	>80%

Appendix B Table 3. Included Studies – Outcomes and Harms

Author, Year Study Name	Weight Assessment Timepoint	Outcomes (Key Question 1)* A=Intervention B=Control	Outcomes (Key Question 2) A=Intervention B=Control	Outcomes (Key Question 3) A=Intervention B=Control	Adherence
Bogaerts et al., 2013[83]	Delivery	NR	A vs. B vs. C Maternal GWG, mean (SD): 10.6 kg (7) vs. 9.5 kg (6.8) vs. 13.5 kg (7.3), p=0.007 GWG <5 kg: 21.1% vs. 27.6% vs. 6.3% GWG 5-8.0 kg: 17.1% vs. 19% vs. 22.2% GWG ≥9 kg: 61.8% vs. 53.4% vs. 71.4% p=0.04 across GWG categories GDM: 11.8% vs. 12.1% vs. 11.1%, p>0.05 Pregnancy-induced HTN: 10.8% vs. 19.3% vs. 9.5%, p>0.05 Preeclampsia: 2.7% vs. 12.3% vs. 6.3%, p>0.05 Caesarean, emergency: 11.9% vs. 15.5% vs. 12.7% Caesarean, elective: 14.5% vs. 8.6% vs. 17.5% p>0.05 across cesarean categories GWG multivariate analysis, B-estimate (SE) GWG, B vs. C: -2.45 (1.2), p=0.04 GWG, A vs. C: -2.89 (1.1), p=0.008 GWG, parity: -1.59 (0.46), p<0.001 GWG, GDM: -3.22 (1.4), p=0.02	A vs. B vs. C Maternal anxiety over time multivariate analysis, B-estimate (SE) A: -2.12 (1.2), p>0.05 B: 2.31 (1.4), p>0.05 C: 4.06 (1.5), p=0.008	NR
Brownfoot et al., 2016[84]	34-36	A vs. B, all p>0.05 Maternal Postpartum hemorrhage: 19.5% vs. 19.4%; OR 1.01, 95% CI, 0.70 to 1.45 Perineal tear (3rd or 4th degree): 2.4% vs. 4%; OR 0.60, 95% CI, 0.26 to 1.38 Maternal death: 0% vs. 0.27% Infant RDS: 1.9% vs. 3.2%; OR 0.57, 95% CI, 0.23 to 1.49 Shoulder dystocia: 1.1% vs. 0% NICU: 11.7% vs. 14%; OR 0.81, 95% CI, 53 to 1.25 Perinatal death: 0.5% vs. 0.5%	A vs. B, all p>0.05 Maternal GWG under guidelines: 12.1% vs. 14.9% GWG within guidelines: 12.7% vs. 12.2% GWG within guidelines by BMI <18.5 kg/m^2: 20% vs. 33.3% GWG within guidelines by BMI 18.5-24.9 kg/m^2: 16.8% vs. 19.7% GWG within guidelines by BMI 24.9-29.9 kg/m^2: 7.7% vs. 6.5% GWG within guidelines by BMI ≥30 kg/m^2: 7.1% vs. 8.1% Excess GWG: 75.2% vs. 70.8% Excess GWG by BMI <18.5 kg/m^2: 60% vs. 50% Excess GWG by BMI 18.5-24.9 kg/m^2: 63.2% vs. 68.9% Excess GWG by BMI 24.9-29.9 kg/m^2: 83.7% vs. 82.8% Excess GWG by BMI ≥30 kg/m^2: 82.1% vs. 75.6% Excess GWG by primiparous: 77.2% vs. 74.9% Excess GWG by multiparous: 72.8% vs. 63.8% Excess GWG by age, <35 years: 77.9% vs. 73.4% Excess GWG by age, ≥35 years: 67.4% vs. 64.7% GDM: 5.4% vs. 5.3%; OR 1.03, 95% CI, 0.55 to 1.91 HTN and preeclampsia: 4.6% vs. 4%; OR 1.16, 95% CI, 0.58 to 2.31 Cesarean, emergency: 15.2% vs. 19.9% Cesarean, elective: 10.2% vs. 11.6% Infant LGA: 7.3% vs. 7.1%; OR 0.99, 95% CI, 0.57 to 1.71	None	NR

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Author, Year Study Name	Weight Assessment Timepoint	Outcomes (Key Question 1)* A=Intervention B=Control	Outcomes (Key Question 2) A=Intervention B=Control	Outcomes (Key Question 3) A=Intervention B=Control	Adherence
Bruno et al., 2017[85]	34-36	A vs. B Infant Neonatal death: 0% vs. 3.2%, p=NR	A vs. B Maternal GWG, mean (SD): 10.1 kg (7.4) vs. 9.4 kg (6.8), p>0.05 GWG within guidelines: 71% vs. 78.7%, p=NR GWG, obese vs. overweight women: 8.9 kg (7.2) vs. 12.4 kg (6.1), p=0.01 GDM: 18.8% vs. 37.1%, p=0.02 GDM, obese vs. overweight women: 33% vs. 11.8%, p=0.02 HTN: 2.9% vs. 21%, p=0.001 Cesarean: 24.6% vs. 40.3%, p>0.05 Infant Macrosomia: 2.9% vs. 11.3%, p>0.05 LGA: 1.4% vs. 11.3%, p=0.02 Preterm birth (weeks NR): 0% vs. 8.1%, p=0.02	A vs. B SGA: 8.7% vs. 8.1%, p>0.05	Adherence to the diet was measured by FFQ score of 2+; 57.9% in A and 38.7% in B were adherent to the diet.
Cahill et al., 2018[86] PreGO	36-Delivery	A vs. B, all p>0.05 Infant RDS: 12% vs. 8.2% NICU: 18.8% vs. 14.3% Neonatal death: 0% vs. 0.8%	A vs. B, all p>0.05 unless noted Maternal GWG, mean (SD): 8.05 kg (5.6) vs. 9.64 kg (5.4), p=0.02 Excess GWG: 36.1% vs. 45.9% GDM: 8.3% vs. 9% HTN: 24.8% vs. 21.1% Cesarean: 41.1% vs. 36.7% Infant LGA: 8.6% vs. 4.8% Preterm birth (<37 weeks): 14.1% vs. 9.5%	A vs. B SGA: 10.2% vs. 10.3%	All participants randomized to the intervention received it.
Haire-Joshu et al., 2019[103]	34-36 (2019 sample)	NR	A vs. B PPWR at 12 months, adjusted mean (SEM): 0.9 kg (6.8) vs. 4.2 kg (8.6), p=0.03 Change in body weight, baseline to 12 months, adjusted mean (SEM): 2.5 kg (7.4) vs. 5.7 kg (8.8), p=0.01 Return to baseline weight or less at 12 months: 38% vs. 21.8%, p=0.01; aRR 2.24, 95% CI, 1.17 to 4.29 PPWR at 12 months, GWG within IOM recommendations vs. exceeding recommendations, mean (SEM): 4.9 kg (7.7) vs. 7.6 kg (8.9), p=0.19 See Figure 2; actual values not reported	NR	75% A: Median 17 visits (IQR 12-21), mean 49.8 min (10.3) per visit B: Median 16 visits (IQR 13-20), mean 38.2 min (13) visits

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Claesson et al., 2010[87]	34-36	NR	NR	A vs. B, all p>0.05 Depression: OR 0.67, 95% CI, 0.29 to 1.58, p>0.05 Symptoms (sx) by GWG <7 kg: 25% vs. 11.1%, p>0.05 Sx by GWG >7 kg: 17% vs. 20%, p>0.05 Sx at 11 weeks postpartum, <7 kg: 6.2% vs. 12.5% Sx at 11 weeks postpartum, >7 kg: 10.6% vs. 7.0% Anxiety: OR 0.74, 95% CI, 0.40 to 1.35 Symptoms (sx) by GWG <7 kg: 24.4% vs. 22.2% Sx by GWG >7 kg: 22.7% vs. 21.6% Sx at 11 weeks postpartum, GWG <7 kg: 6.2% vs. 12.5% Sx at 11 weeks postpartum, GWG >7 kg: 8.2% vs. 10%	NR

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Author, Year Study Name	Weight Assessment Timepoint	Outcomes (Key Question 1)* A=Intervention B=Control	Outcomes (Key Question 2) A=Intervention B=Control	Outcomes (Key Question 3) A=Intervention B=Control	Adherence
Daley et al., 2015[88]	36-Delivery	NR	A vs. B, p=NR Maternal GWG, mean (SD): 12.0 kg (4.5) vs. 12.1 kg (5.9) GWG by BMI normal weight, mean (SD): 12.3 kg (4.0) vs. 12.6 kg (5.1) GWG by BMI overweight, mean (SD): 11.6 kg (5.1) vs. 11.6 kg (7.0) Excess GWG: 23.5% vs. 29.4% Excess GWG by BMI normal weight: 11.1% vs. 10.5% Excess GWG by BMI overweight: 37.5% vs. 53.3%	A vs. B, p=NR *Note: Hospital Anxiety and Depression Scale >11 indicates abnormal, <7 is normal HADS baseline, mean (SD): 7.9 (5) vs. 8.2 (5) HADS 38 weeks, mean (SD): 8.5 (4.6) vs. 11.1 (5.7) HADS postnatal, mean (SD): 7.6 (3.9) vs. 7.7 (4.9)	90% completed 72 hour weight; 89% completed 6-8 week postpartum weigh-in.
Daley et al., 2019[89] POPS2	36-Delivery	A vs. B Infant Shoulder dystocia: 1% (3/312) vs. 0.6% (2/314) NICU: 10% (26/261) vs. 8% (21/262) Stillbirth: 0 vs. 0.3% (1/316)	A vs. B, all p>0.05 Maternal GWG, mean (SD): 10.3 kg (5.9) vs. 10.7 kg (6.9), aMD -0.42 kg, 95% CI −1.49 to 0.64 GWG below guidelines: 40.9% (125/305) vs. 36.5% (114/311), aOR 1.26, 95% CI, 0.86 to 1.82 GWG within guidelines: 31.5% (96/305) vs. 34.6% (108/311), aOR 0.92, 95% CI, 0.63 to 1.32 Excess GWG: 27.6% (81/305) vs. 28.9% (90/311), aOR 0.84, 95% CI, 0.53 to 1.33 Excess GWG by BMI normal weight: 10.3% (15/148) vs. 13.5% (22/161), aOR 0.69, 95% CI, 0.22 to 2.21 Excess GWG by BMI overweight: 39.8% (38/95) vs. 36.6% (34/93), aOR 1.11, 95% CI, 0.60 to 2.04 Excess GWG by BMI obese: 50.3% (31.62) vs. 59.6% (34/57), aOR 0.69, 95% CI, 0.30 to 1.58 GDM: 3.8% (12/315) vs. 5.4% (17/317) Preeclampsia: 1.9% (6/315) vs. 2.5% (8/317) Cesarean: 22.4% (68/304) vs. 22.8% (69/302) Infant Preterm birth (<37 weeks): 5.6% (17/304) vs. 4.6% (14/302)	A vs. B, p>0.05 HADS Anxiety baseline, mean (SD): 4.88 (3.5) vs. 5.15 (3.3) HADS Anxiety 38 weeks, mean (SD): 5.18 (3.1) vs. 5.89 (3.6); aMD -0.58, 95% CI, -1.25 to 0.08, p>0.05 HADS Depression baseline, mean (SD): 3.29 (2.9) vs. 3.49 (3.3) HADS Depression 38 weeks, mean (SD): 3.93 (3.0) vs. 4.56 (3.0); aMD -0.60, 95% CI, -1.24 to 0.05, p>0.05	50.9% weighed themselves five times or more

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Author, Year Study Name	Weight Assessment Timepoint	Outcomes (Key Question 1)* A=Intervention B=Control	Outcomes (Key Question 2) A=Intervention B=Control	Outcomes (Key Question 3) A=Intervention B=Control	Adherence
Daly et al., 2017[90] Healthy eating, Exercise and Lifestyle Trial	34-36	A vs. B Infant NICU: 9.1% vs. 16.3%, p>0.05	A vs. B Maternal GWG, mean (SD): 6.2 kg ((6) vs. 7.9 kg (7.8), p>0.05 Excess GWG: 22.2% vs. 43.2%, p<0.05 PPWR (6 weeks), mean (SD): -1.6 kg (1.2) vs. 0.2 kg (5.4) GDM: 58.1% vs. 48.8%, p<0.05 Cesarean, emergency: 18.2% vs. 20.9%, p>0.05 Cesarean, elective: 15.9% vs. 18.6%, p>0.05 Infant Macrosomia (>4,500 g): 2.3% vs. 0, p=0.51 LGA: 6.8% vs. 4.6%, p>0.05 Preterm birth (<37 weeks): 4.5% vs. 2.3%, p>0.05	A vs. B Low birth weight (<2,500 g): 0% vs. 2.3%, p>0.05	64% in Group A attended at least one class per week; 41% attended at least three classes every 2 weeks.
Dodd et al., 2014[56] LIMIT	36-Delivery	A vs. B, all p>0.05 Maternal Postpartum hemorrhage: 18% vs. 17%; aMD 0.94, 95% CI, 0.77 to 1.14 Perineal tear (3rd or 4th degree): 3% vs. 2%; aMD 1.36, 95% CI, 0.77 to 2.40 Infant Shoulder dystocia: 4% vs. 3%; aMD 1.25, 95% CI, 0.81 to 1.93 NICU: 37% vs. 36%; aMD 1.00, 95% CI, 0.90 to 1.12 Neonatal death: 0.47% vs. 0.47%	A vs. B, all p>0.05 unless noted GWG, mean (SD): 9.4 kg (5.7) vs. 9.4 kg (5.8); aMD -0.04, 95% CI, -0.55 to 0.48 GWG below guidelines: 25% vs. 24.9%; aMD 0.99, 95% CI, 0.84 to 1.15 GWG within guidelines: 32.7% vs. 32.8%; aMD 1.02, 95% CI, 0.89 to 1.17 Excess GWG: 42.4% vs. 42.3%; aMD 0.99, 95% CI, 0.89 to 1.10 GDM: 14% vs. 11%; aMD 1.21, 95% CI, 0.96 to 1.52 HTN: 9% vs. 9%; aMD 1.05, 95% CI, 0.81 to 1.38 Preeclampsia: 5% vs. 5%; aMD 1.03, 95% CI, 0.71 to 1.47 Cesarean: 34% vs. 37%; aMD 0.95, 95% CI, 0.85 to 1.06 Infant Macrosomia: 15% vs. 19%; aMD 0.82, 95% CI, 0.68 to 0.99, p=0.04 LGA: 19% vs. 21%; aMD 0.90, 95% CI, 0.77 to 1.07 Preterm birth (<37 weeks): 6% vs. 8%; aMD 0.74, 95% CI, 0.54 to 1.02	None related to study intervention	87% attended first session with research dietician, 77% attended second session
Dodd et al., 2018[91]	Same as Dodd et al., 2014	NR	A vs. B, all adjusted p>0.05 Infant Weight (6 months), mean (SD): 8.3 kg (1.3) vs. 8.3 kg (1.3) BMI (6 months), mean (SD): 17.7 kg/m^2 (1.8) vs. 17.7 kg/m^2 (1.8)	Same as Dodd et al., 2014	Same as Dodd et al., 2014

Appendix B Table 3. Included Studies – Outcomes and Harms

Dodd et al., 2019[92] OPTIMISE	36-Delivery	A vs. B Maternal Postpartum hemorrhage (>600 mL): 16.8% (53/316) vs. 14.4% (45/313), aRR 1.16, 95% CI, 0.80 to 1.67 Perineal tear, all: 58.2% (184/316) vs. 60.3% (189/313), aRR 0.98, 95% CI, 0.86 to 1.11 Perineal tear, 3rd/4th degree: 2.9% (9/316) vs. 1.6% (5/313), aRR 1.69, 95% CI, 0.57 to 4.97 Infant Shoulder dystocia: 2.9% (9/316) vs. 4.2% (13/313), aRR 0.69, 95% CI 0.30 to 1.6 NICU admission: 8.5% (27/316) vs. 10.9% (34/313), aRR 0.80, 95% CI 0.5 to 1.3 Death: 0.6% (2/316) vs. 0	A vs. B Maternal GWG, mean (SD): 11.3 kg (4) vs. 11.7 kg (3.8), aMD -0.37, 95% CI, -0.97 to 0.23 GWG below guidelines: 50.7% (160/316) vs. 51.7% (162/313), aOR 0.85, 95% CI, 0.60 to 1.21 GWG within guidelines: 40.6% (128/316) vs. 35.2% (110/313) Excess GWG: 8.7% (28/316) vs. 13.2% (41/313), aOR 0.58, 95% CI, 0.32 to 1.04 GDM: 12.4% (39/316) vs. 12.5% (39/313), aRR 1.02, 95% CI, 0.66 to 1.59 HTN: 1.6% (5/316) vs. 1.3% (4/313), aRR 1.87, 95% CI, 0.52 to 6.7 Preeclampsia: 1.9% (6/316) vs. 2.9% (9/313), aRR 0.7, 95% CI 0.25 to 1.96 Cesarean, all: 23.2% (73/316) vs. 23.8% (74/313), aRR 0.95, 95% CI, 0.72 to 1.26 Cesarean, emergency: 13% (41/316) vs. 14.5% (45/313), aRR 0.89, 95% CI, 0.6 to 1.31 Infant Macrosomia (>4 kg): 7.6% (24/316) vs. 8.3% (26/313), aRR 0.91, 95% CI, 0.54 to 1.55 Macrosomia (>4.5 kg): 0 vs. 0.6% (2/313) LGA: 7% (22/316) vs. 8% (25/313), aRR 0.88, 95% CI, 0.51 to 1.52 Preterm birth (<37 weeks): 7.3% (23/316) vs. 6.4% (20/313), aRR 1.14, 95% CI, 0.64 to 2.03	A vs. B *Note: SF-12, 100=highest health; EPDS, >12=abnormal; STAI, >15=abnormal Maternal SF-12 Mental Score, mean (SD) Baseline: 41.3 (10.7) vs. 41.6 (10.4); aMD -0.33, 95% CI, -2.00 to 1.34 28 weeks: 46.3 (10.1) vs. 45.1 (10); aMD 1.23, 95% CI, -0.33 to 2.80 36 weeks: 46.3 (9.9) vs. 46.2 (9.5); aMD 0.08, 95% CI, -1.41 to 1.58 EPDS Total Score, mean (SD) Baseline: 5 (4.4) vs. 5.1 (4.4); aMD -0.05, 95% CI, -0.74 to 0.64 28 weeks: 5.6 (4.2) vs. 6.1 (4.8); aMD -0.48; 95% CI, -1.18 to 0.23 36 weeks: 5.4 (4.2) vs. 5.2 (4.5); aMD 0.21, 95% CI, -0.47 to 0.89 STAI Score, mean (SD) Baseline: 10.4 (3.5) vs. 10.7 (3.7); aMD -0.34, 95% CI, -0.90 to 0.23 28 weeks: 9.9 (3.5) vs. 10.4 (3.6); aMD -0.50, 95% CI, -1.06 to 0.05 36 weeks: 9.9 (3.3) vs. 10.3 (3.7); aMD -0.41, 95% CI, -0.95 to 0.13	NR

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Author, Year Study Name	Weight Assessment Timepoint	Outcomes (Key Question 1)* A=Intervention B=Control	Outcomes (Key Question 2) A=Intervention B=Control	Outcomes (Key Question 3) A=Intervention B=Control	Adherence
				Infant SGA: 6.7% (21/316) vs. 8% (25/313), aRR 0.84, 95% CI, 0.48 to 1.47 Low birth weight (<2,500 g): 6.3% (20/316) vs. 4.8% 915/313), aRR 1.32, 95% CI, 0.69 to 2.54	
Epel et al., 2019[93] MMT	36-Delivery	NR	NA	A vs. B Change from baseline to post-intervention, mean (SD) Perceived stress (0-40): 15.6 (5.8) vs. 17 (7.4); -2.09, 95% CI, -4.04 to -0.14, p=0.04 Depressive symptoms (0-27): 4.5 (3.7) vs. 6.1 (4.5); -1.95, 95% CI, -3.35 to -0.55, p=0.007 Pregnancy anxiety (1-4): 2.0 (0.7) vs. 2.0 (0.6); 0.01, 95% CI, -0.17 to 0.19, p=0.9 See Table 2 for baseline scores	Mean 5.7 sessions (median 7); 75% attended 5+ sessions.

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Author, Year Study Name	Weight Assessment Timepoint	Outcomes (Key Question 1)* A=Intervention B=Control	Outcomes (Key Question 2) A=Intervention B=Control	Outcomes (Key Question 3) A=Intervention B=Control	Adherence
Gallagher et al., 2018[94] LIFT	Delivery	NR	A vs. B Maternal GWG, mean (SD): 7.89 kg (4.07) vs. 9.67 kg (4.17), p=0.003 GWG by BMI overweight, mean (SD): 9.01 kg (3.55) vs. 10.33 kg (4.0), p>0.05 GWG by BMI obese, mean (SD): 6.07 kg (4.24) vs. 8.75 kg (4.27), p=0.007 Cesarean: 30% vs. 31%, p>0.05 Infant LGA: 10% vs. 6%, p>0.05 Preterm birth (<37 weeks): 5% vs. 7%, p>0.05	A vs. B SGA: 8% vs. 14%, p>0.05	Visits <27 weeks: 87.5% Visits up to delivery: 72% Food logs, <27 weeks: 67.5% Food logs, overall: 51.1% Exercise logs, <27 weeks: 52.5% Exercise logs, overall: 34.2% Exercise class attendance: 9.7%
Garnaes et al., 2016[97] ETIP	Delivery	NR	A vs. B, all p>0.05 unless noted Maternal GWG, mean (95% CI): 10.5 kg (8.9 to 12.0) vs. 9.2 kg (6.8 to 11.6); MD 1.29, 95% CI, -1.58 to 4.05 Excess GWG: 58.3% vs. 44.4%, OR 0.6, 95% CI, 0.23 to 1.45 GDM (2009 criteria): 6.1% vs. 27.3%, OR 0.1, 95% CI, 0.02 to 0.95, p=0.04 GDM (2013 criteria): 14.7% vs. 24.2%, OR 0.5, 95% CI, 0.13 to 2.35 HTN: 9.1% vs. 22.6%, OR 0.2, 95% CI, 0.02 to 1.98 Infant Preterm birth (<37 weeks): 2.2% vs. 2.2%	NR	50% fulfilled training intervention as described in study protocol.
Garnaes et al., 2017[98]	Same as Garnaes et al., 2016	A vs. B Maternal Perineal tear (3rd or 4th degree): 18% vs. 10%; OR 0.7, 95% CI, 0.08 to 2.91, p>0.05	A vs. B, all p>0.05 Maternal Cesarean: 24% vs. 17%, OR 0.8, 95% CI, 0.50 to 1.33 Infant Macrosomia: 35% vs. 53%, OR 1.4, 95% CI, 0.88 to 2.36	Same as Garnaes et al., 2016	Same as Garnaes et al., 2016
Garnaes et al., 2018[96]	Same as Garnaes et al., 2016	NR	A vs. B PPWR (vs. baseline), mean kg (95% CI): -0.8 (-2.7 to 1.1) vs. -1.6 (-3.5 to 0.3), p=0.54 PPWR (vs. self-report prepregnancy weight), mean kg (95% CI): 1.52 (-0.73 to 3.78) vs. 0.52 (-1.82 to 2.86), p=0.53 Association PPWR and GWG: p=0.79 Association PPWR and lactation: p=0.63	Same as Garnaes et al., 2016	54.3% in intervention group adhered to protocol; mean 31.7 supervised sessions and 19.2 home sessions.

Appendix B Table 3. Included Studies – Outcomes and Harms

Author, Year Study Name	Weight Assessment Timepoint	Outcomes (Key Question 1)* A=Intervention B=Control	Outcomes (Key Question 2) A=Intervention B=Control	Outcomes (Key Question 3) A=Intervention B=Control	Adherence
Garnaes et al., 2019[95]	Same as Garnaes et al., 2016	NR	NR	A vs. B PWBGI global score Baseline, mean (SD): 76.6 (11.1) vs. 76.2 (14.3) Late pregnancy (34-37 weeks), mean (95% CI): 76.6 (72.2 to 81) vs. 74 (69.4 to 78.5); aMD 2.60, 95% CI, −3.77 to 8.97 3 months postpartum, mean (95% CI): 85.4 (81.9 to 88.8) vs. 84.6 (80.8 to 88.4); aMD 0.77, 95% CI, −4.42 to 5.95 EPSD, 3 months postpartum, mean (95% CI): 2.96 (1.7 to 4.2) vs. 3.48 (2.3 to 4.7)	Same as Garnaes et al., 2018
Gesell et al., 2015[99] Madre Sana, Bebé Sano / Healthy Mother, Healthy Baby	36-Delivery	NR	A vs. B Maternal GWG, mean (SD): 19.5 lbs (12.3) vs. 22.4 lbs (15.6), p>0.05 GWG within recommendations by BMI normal weight: 40% vs. 17.6%, p=0.04 GWG within recommendations by BMI overweight: 50% vs. 20%, p<0.05 GWG within recommendations by BMI obese: 26.7% vs. 45.5%, p<0.05 Excess GWG: 27.3% vs. 44.2%, p>0.05 Excess GWG by BMI normal weight: 6.7% vs. 47.1%, p=0.04 Excess GWG by BMI overweight: 28.6% vs. 40%, p>0.05 Excess GWG by BMI obese: 46.7% vs. 45.5%, p>0.05	NR	On average, attended 4.14 (3.85) of 12 sessions, 16 (23.5%) attended no sessions, 9 attended 1 session (13.2%), only 2 (2.9%) attended 12 sessions.

Appendix B Table 3. Included Studies – Outcomes and Harms

Author, Year Study Name	Weight Assessment Timepoint	Outcomes (Key Question 1)* A=Intervention B=Control	Outcomes (Key Question 2) A=Intervention B=Control	Outcomes (Key Question 3) A=Intervention B=Control	Adherence
Gray-Donald, et al., 2000[100]	Delivery	NR	A vs. B, all p=NR unless noted Maternal GWG, mean (SD): 12 kg (6.4) vs. 13.2 kg (8.3), p>0.05 GWG, BMI ≤29 kg/m^2 vs. BMI >29 kg/m^2, mean (SD): 16.1 kg (17.4) vs. 9.5 kg (6) GDM (95% CI): 16.2% (9.2% to 23.3%) vs. 14.7% (7.6% to 21.8%) PPWR, mean (SD): 6.1 kg (6.7) vs. 7.4 kg (8.5) Cesarean: 14.2% vs. 12.6% Infant Macrosomia: 34.9% vs. 30.1%	A vs. B Low birth weight (<2,500 g): 2.8% vs. 1.9%	NR
Guelfi et al., 2016[101]	Delivery	A vs. B, p=NR Maternal Postpartum hemorrhage: 2.4% (2/84) vs. 3.5% (3/85) Infant NICU: 9.4% (8/84) vs. 16.5% (14/85)	A vs. B, all p>0.05 Maternal GDM: 40.5% (34/84) vs. 40% (34/85), RR 1.01, 95% CI, 0.70 to 1.46, p=0.95 Preeclampsia: 2.4% (2/84) vs. 1.2% (1/85) Cesarean, emergency: 11.9% (10/84) vs. 12.9% (11/85) Cesarean, elective: 29.8% (25/84) vs. 30.6% (26/85) Infant LGA: 14.2% (12/84) vs. 11.8% (10/85) Preterm birth (time NR): 3.6% (3/84) vs. 4.7% (4/85)	A vs. B, p=NR unless indicated Maternal EPDS baseline, score 12+: 5.9% (5/84) vs. 2.3% (2/85) EPDS, score 12+: 1.2% (1/84) vs. 3.5% (3/85) DASS-21 baseline, median (IQR): 6 (4-12) vs. 8 (4-11) DASS-21, median (IQR): 6 (2-10) vs. 7 (4-11), p<0.05 SPAS total baseline, median (IQR): 32 (23-39.5) vs. 28.5 (18-37) SPAS total baseline, median (IQR): 29 (19-38) vs. 26 (18-35) Infant SGA: 0 vs. 2.4% (2/85)	Median 86% of sessions completed (IQR 79-95%).

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Author, Year Study Name	Weight Assessment Timepoint	Outcomes (Key Question 1)* A=Intervention B=Control	Outcomes (Key Question 2) A=Intervention B=Control	Outcomes (Key Question 3) A=Intervention B=Control	Adherence
Haakstad et al., 2011[102]	36-Delivery	NR	A vs. B, p>0.05 for all comparisons Maternal GWG, mean (SD): 13.0 kg (4.0) vs. 13.8 kg (4.0) Excess GWG: 33% vs. 38% PPWR (SD): 3.3 kg (3.9) vs. 3.3 kg (4.1) Infant Preterm birth (<37 weeks): 0% vs. 1.9%	None related to study intervention	Attended ≥80% of sessions: 40% Attended all sessions: 27%
Harrison et al., 2013[104] HeLP-her	28 weeks	NR	A vs. B Maternal GWG, mean (SD): 6 kg (2.8) vs. 6.9 kg (3.3), p<0.05 GWG by BMI overweight, mean (SD): 6 kg (2.2) vs. 7.8 kg (3.4), p<0.05 GWG by BMI obese, mean (SD): 5.2 kg (SD 2.6) vs. 5.9 kg (SD 3.5), p>0.05 GDM: 22.3% vs. 32.7%; RR 0.68, 95% CI, 0.44 to 1.05, p<0.01	NR	NR
Harrison et al., 2014[105]	Same as Harrison et al., 2013	NR	A vs. B Maternal PPWR (6 weeks), mean (SD): 0.51 kg (4.48) vs. 1.96 kg (5.74), p<0.05 PPWR by BMI overweight, mean (SD): 1.48 kg (3.9) vs. 3.3 kg (5.6), p<0.05 PPWR by BMI obese, mean (SD): -0.76 kg (4.9) vs. -0.22 kg (5.4), p>0.05 PPWR by GDM negative diagnosis, mean (SD): 1.4 kg (3.9) vs. 3 kg (5.9), p<0.05 PPWR by GDM positive diagnosis, mean (SD): -3.1 kg (5.7) vs. -1.9 kg (3.7), p>0.05	NR	NR
Hawkins et al., 2014[106] Estudio Vida	Delivery	NR	A vs. B Maternal GWG, mean (SD): 17.7 kg (1) vs. 17.9 kg (0.6), p>0.05	NR	NR

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Author, Year Study Name	Weight Assessment Timepoint	Outcomes (Key Question 1)* A=Intervention B=Control	Outcomes (Key Question 2) A=Intervention B=Control	Outcomes (Key Question 3) A=Intervention B=Control	Adherence
Herring et al., 2016[108]	36-Delivery	NR	A vs. B Maternal GWG, mean (SD): 8.7 kg (6.6) vs. 12.3 kg (6.4) kg; aMD -3.1, 95% CI, -6.2 to -0.1, p<0.05 GWG by BMI overweight, mean: 12.4 kg vs. 16.1 kg, p=NR GWG by BMI obese, mean: 7.2 kg vs. 10.6 kg, p=NR GWG within guidelines: 26% vs. 17%, p=0.03 Excess GWG: 37% vs. 66%, p=0.03; OR 0.3, 95% CI, 0.1 to 1.0, p<0.05 GDM: 4% vs. 4%, p>0.05 Cesarean: 48% vs. 36%, p>0.05 Infant LGA: 4% vs. 0%, p>0.05	A vs. B SGA: 8% vs. 7%, p>0.05	Response to text messages: mean 65.2 (out of 114 texts sent) Responded to ≥50% of texts: 70% Mean coaching calls completed during first 12 weeks: 4 (out of 7 calls) Commented or liked Facebook posts: 11%
Herring et al., 2017[107]	Same as Herring et al., 2016	NR	A vs. B Maternal Proportion at or below early pregnancy weight at 6 months postpartum: 56% vs. 29%, p=0.04; aOR 3.5, 95% CI, 1.0 to 11.8, p=0.04 Proportion at or below early pregnancy weight at 12 months postpartum: 41% vs. 38%, p>0.05	NR	NR
Hui et al., 2012[110]	Delivery	NR	A vs. B, all p>0.05 unless noted Maternal GWG, mean (SD): 14.1 kg (6.0) vs. 15.2 kg (5.9) Excess GWG: 35.3% vs. 54.5%, p=0.008 GDM: 1.8% vs. 3.3% Cesarean: 2% vs. 3.4% Infant LGA: 11.8% vs. 17%	NR	NR

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Author, Year Study Name	Weight Assessment Timepoint	Outcomes (Key Question 1)* A=Intervention B=Control	Outcomes (Key Question 2) A=Intervention B=Control	Outcomes (Key Question 3) A=Intervention B=Control	Adherence
Hui et al., 2014[111]	Delivery	NR	A vs. B, all p>0.05 unless noted Maternal GWG by BMI normal weight, mean (SD): 12.9 kg (3.7) vs. 16.2 kg (4.4), p=0.03 GWG by BMI overweight, mean (SD): 15.2 kg (7.5) vs. 14.4 kg (7.1) Excess GWG by BMI normal weight: 10% vs. 37% (10/27), p=0.03 Excess GWG by BMI overweight: 67% vs. 69% GDM, BMI normal weight: 0% vs. 0% GDM, BMI overweight: 4% vs. 10% Cesarean, BMI normal weight: 0% vs. 0% Cesarean, BMI overweight: 0% vs. 7% Infant LGA, BMI normal weight: 7% vs. 11% LGA, BMI overweight: 15% vs. 3%	"None of the participants discontinued during the participation. No complaint to the program was reported by the participants."	100%
Koivusalo et al., 2016[114] RADIEL	Delivery	A vs. B Infant RDS: 4.9% vs. 5.6%, p>0.05	A vs. B, all p>0.05 unless noted Maternal GWG, mean (95% CI): 7.6 kg (6.7 to 8.3) vs. 7.7 kg (7.1 to 8.4) GDM, mean (95% CI): 13.9% (8.7 to 20.6) vs. 21.6% (14.7 to 29.8), adjusted p=0.04 HTN: 4.9% vs. 4.5% Preeclampsia: 4.9% vs. 2.4% Cesarean: 21.5% vs. 24.0% Infant Macrosomia: 4.2% vs. 4.0%	NR	PA only: 26% (A) and 23% (B) met PA goal in second trimester. Adjusted weight change in follow-up not significant.
Huvinen et al., 2018[112]	Same as Koivusalo et al., 2016	NR	A vs. B Maternal PPWR (6 weeks): Specific data NR, p>0.05 PPWR (12 months): Specific data NR, p>0.05 See Figure 3	Same as Koivusalo et al., 2016	Same as Koivusalo et al., 2016
Rono et al., 2018a[137]	Same as Koivusalo et al., 2016	A vs. B Infant RDS: 5% (3/65) vs. 8% (4/63), p=0.85	A vs. B Maternal GWG, mean (95% CI): 9.6 kg (7.8 to 11.5) vs. 9.2 kg (7.6 to 10.8), adjusted p=0.93 GDM: 60% (39/65) vs. 54% (34/63), adjusted p=0.61 Early GDM (mean 13.3 weeks): 64% (25/39) vs. 56% (19/34), p=0.47 Pregnancy-induced HTN: 6% (4/65) vs. 2% (3/63), p=0.36 Essential HTN: 5% (3/65) vs. 6% (5/63), p=0.35 Preeclampsia: 2% (1/65) vs. 2% (1/63), p=0.99	Same as Koivusalo et al., 2016	38% (A) and 52% (B) attended only one prepregnancy visit; mean duration baseline visit to conception 4.6 months (A) and 3.8 months (B).

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Author, Year Study Name	Weight Assessment Timepoint	Outcomes (Key Question 1)* A=Intervention B=Control	Outcomes (Key Question 2) A=Intervention B=Control	Outcomes (Key Question 3) A=Intervention B=Control	Adherence
Rono et al., 2018b[136]	Same as Koivusalo et al., 2016	A vs. B Infant RDS: 6.8% (16/235) vs. 5.7% (13/229), p=0.62	A vs. B Maternal GDM: 44.8% (107/239) vs. 48.1% (111/231), adjusted p=0.44; OR 0.88, 95% CI, 0.61 to 1.26 Early GDM (<20 weeks): 37.7% (87/231) vs. 36.5% (72/197), p=0.81 Gestational HTN: 7.7% (18/235) vs. 5.7% (13/229), p=0.39 Essential HTN: 6.4% (15/235) vs. 3.9% (9/229), p=0.23 Preeclampsia: 6% (14/235) vs. 3.1% (7/229), p=0.13 Cesarean: 23.4% (55/235) vs. 25.8% (59/229), p=0.56 Infant LGA: 3.4% (8/235) vs. 5.7% (13/229), p=0.24 Preterm birth (<37 weeks): 5.1% (12/235) vs. 3.1% (7/229), p=0.27	Same as Koivusalo et al., 2016	63.2% (A) and 59.3% (B) returned both food diaries; 44.8% (A) and 46.3% (B) returned both physical activity diaries.

Appendix B Table 3. Included Studies – Outcomes and Harms

Author, Year Study Name	Weight Assessment Timepoint	Outcomes (Key Question 1)* A=Intervention B=Control	Outcomes (Key Question 2) A=Intervention B=Control	Outcomes (Key Question 3) A=Intervention B=Control	Adherence
Kunath et al., 2019[115] GeliS	NR	NR	A vs. B Maternal GWG, mean kg (SD): 14.1 (5.3) vs. 14.1 (5.2); aOR 0.09, 95% CI, -0.79 to 0.97, p=0.84 GWG, BMI normal, mean kg (SD): 14.6 (4.5) vs. 14.8 (4.6); aOR -0.10, 95% CI, -0.93 to 0.72, p=0.81 GWG, BMI overweight, mean kg (SD): 14 (6) vs. 14.1 (5.5); aOR -0.26, 95% CI, -1.14 to 0.63, p=0.57 GWG, BMI obese, mean kg (SD): 11.5 (6.8) vs. 10.6 (6.5); aOR 0.52, -1.05 to 2.09, p=0.51 aMD, BMI groups: 0.1 kg, 95% CI, -0.8 to 1.0, p=0.84 GWG below IOM recommendations: 21.4% vs. 19.9% (n NR) Excess GWG: 45.1% (427/946) vs. 45.7% (429/939); aOR 0.95, 95% CI, 0.66 to 1.38, p=0.79 Excess GWG, BMI normal: 34.2% (208/608) vs. 35.9% (224/624); aOR 0.92, 95% CI, 0.61 to 1.38, p=0.67 Excess GWG, BMI overweight: 62.2% (150/230) vs. 69% (138/200); aOR 0.81, 95% CI, 0.51 to 1.29, p=0.38 Excess GWG, BMI obese: 63.9% (69/108) vs. 58.3% (67/115); aOR 1.08, 95% CI, 0.62 to 1.87, p=0.79 PPWR (6-8 weeks), mean kg (SD): 4 (4.8) vs. 4.3 (4.8); aOR -0.19, 95% CI, -1.01 to 0.63, p=0.65 [A n=976, B n=934] GDM: 10.8% (109/1008) vs. 11.1% (106/954); aOR 0.84, 0.41 to 1.71, p=0.62 HTN: 9.5% (99/1041) vs. 6.4% (66/1039); aOR 1.64, 95% CI, 1.09 to 2.45, p=0.017 Preeclampsia: 1.4% (14/1006) vs. 1.3% (13/965) Cesarean, emergency: 14.8% (150/1016) vs. 15.9% (159/1003); aOR 0.86, 95% CI, 0.67 to 1.12, p=0.26 Cesarean, elective: 15.5% (157/1016) vs. 11.6% (117/1003); aOR 1.41, 95% CI, 1.08 to 1.85, p=0.02 Infant Macrosomia: 1.3% (13/1015) vs. 0.6% (6/1003); aOR 2.28, 95% CI, 0.66 to 7.90, p=0.20 LGA: 7.2% (73/1013) vs. 7.5% (75/1003); aOR 1.01, 95% CI, 0.86 to 1.20, p=0.86 Preterm birth (<37 weeks): 7.1% (72/1014) vs. 6% (60/1004); aOR 1.18, 95% CI, 0.78 to 1.79, p=0.44	A vs. B SGA: 8.7% (88/1013) vs. 8.4% (84/1003); aOR 1.03, 95% CI, 0.82 to 1.31, p=0.78	87.6% attended all sessions; 93.7% attended the postpartum session.

Appendix B Table 3. Included Studies – Outcomes and Harms

Author, Year Study Name	Weight Assessment Timepoint	Outcomes (Key Question 1)* A=Intervention B=Control	Outcomes (Key Question 2) A=Intervention B=Control	Outcomes (Key Question 3) A=Intervention B=Control	Adherence
Hoffman et al., 2019[109]	Same as Kunath et al., 2019	Same as Kunath et al., 2019	A vs. B Maternal PPWR (6-8 weeks), mean (SD): 4 kg (4.8) vs. 4.3 kg (4.8); adjusted effect size -0.14, 95% CI, -0.96 to 0.68, p=0.74 Women at or below prepregnancy weight: 11.3% (110/973) vs. 14.6% 136/934), p=0.04 PPWR (12 months), mean (SD): -0.2 kg (4.8) vs. 0.6 kg (5.2); adjusted effect size -0.74, 95% CI, -1.55 to 0.07, p=0.08 Women at or below prepregnancy weight: 40.5% (341/843) vs. 40.1% (334/832), p=0.82 Predictors of long-term PPWR BMI overweight vs. BMI normal weight: adjusted effect size 1.01, 95% CI, 0.28 to 1.74, p=0.006 BMI obese vs. BMI normal weight: adjusted effect size 0.44, 95% CI, -0.82 to 1.70, p=0.49 BMI category overall, adjusted p=0.01 Excessive GWG vs. non-excessive GWG: adjusted effect size 2.25, 95% CI, 1.74 to 2.77, p<0.001 PPWR ≤5 kg vs. PPWR >5 kg: adjusted effect size, 3.82, 95% CI, 3.36 to 4.28, p<0.001 Exclusive breastfeeding vs. not exclusive breastfeeding: adjusted effect size -1.13, 95% CI, -1.92 to -0.33, p=0.005	NR	NR
LeBlanc et al., 2020[116] PREPARE	36-Delivery	NR	A vs. B Maternal Prepregnancy weight reduction, mean (SD): 3.7 kg (8.3) vs. 0.6 kg (8.1) Prepregnancy weight reduction per week, mean (SD): 0.25 kg (0.5) vs. 0.03 kg (0.2), p<0.001 Prepregnancy BMI reduction, mean (SD): 1.32 kg/m^2 (2.9) vs. 0.25 kg/m^2 (2.9), p=0.02 GWG, mean (SD): 13.2 kg (8.2) vs. 10.3 kg (7.4), p=0.03 Excessive GWG: 66.7% (50/75) vs. 54.5% (36/66); OR 1.67, 95% CI, 0.84 to 3.30	NR	70.9% for weekly calls, 73.3% for monthly calls
Luoto et al., 2011[117] NELLI	36-Delivery	NR	A vs. B, all p>0.05 unless noted Maternal GWG, mean (SD): 13.8 kg (5.8) vs. 14.2 kg (5.1); aMD -0.43, 95% CI, -1.52 to 0.67 GDM: 15.8% vs. 12.4% Preeclampsia: 6.5% vs. 5.9%; aOR 1.32, 95% CI, 0.53 to 3.31 Infant Macrosomia (>4,000 g): 17.2% vs. 20.8%; aOR 0.83, 95% CI, 0.47 to 1.47 Macrosomia (>4,500 g): 3.3% vs. 4.6%; aOR 0.65, 95% CI, 0.13 to 3.38 LGA: 12.1% vs. 19.7%; aOR 0.55, 95% CI, 0.30 to 0.98, p=0.04	A vs. B SGA: 4.7% vs. 2.9%; aOR 1.89, 95% CI, 0.56 to 6.37	24%, as reported in the editors' summary.

Appendix B Table 3. Included Studies – Outcomes and Harms

Author, Year Study Name	Weight Assessment Timepoint	Outcomes (Key Question 1)* A=Intervention B=Control	Outcomes (Key Question 2) A=Intervention B=Control	Outcomes (Key Question 3) A=Intervention B=Control	Adherence
Kinnunen et al., 2012[113]	Same as Luoto et al., 2011	NR	A vs. B Maternal GWG updated, mean (SD): 13.7 kg (5.8) vs. 14.3 kg (5.0), p>0.05 GWG within recommendations: 25.9% vs. 27.8%, p=NR Excess GWG: 46.8% vs. 54.4%; adjusted OR 0.82, 95% CI, 0.53 to 1.26, p>0.05	NR	NR
Magriples et al., 2015[118] Centering Pregnancy Plus	Delivery	NR	A vs. B Maternal Excess GWG: 48.8% vs. 51.6%, p>0.05	NR	NR
McCarthy et al., 2016[119] FFF	34-36	A vs. B, p=NR for all Maternal Postpartum hemorrhage (>1,000 mL): 7.9% vs. 7.8% Perineal tear (3rd or 4th degree): 3.4% vs. 2.7% Maternal death: 0% vs. 0% Infant Shoulder dystocia: 1.6% vs. 2.7%	A vs. B Maternal GWG, MD (95% CI): -0.88 kg (-2.0 to 0.25), p>0.05 GWG by BMI overweight, mean (SD): 9.86 kg (4.4) vs. 10.5 kg (4.2); MD -0.63 kg, 95% CI, -2.01 to 0.74, p>0.05 GWG by BMI obese, mean (SD): 7.40 kg (6.1) vs. 8.77 (6.6); MD -1.37 kg, 95% CI, -3.34 to 0.60, p>0.05 GWG within recommendation by BMI overweight: 39% vs. 48.6%, p>0.05 GWG within recommendation by BMI obese: 25.6% vs. 22.5%, p>0.05 GDM: 19.5% vs. 18.3%, p=NR HTN or preeclampsia: 9.1% vs. 10.3%, p=NR Caesarean, emergency: 19.3% vs. 22.2%, p=NR Caesarean, elective: 15.0% vs. 20.1%, p=NR	NR	Adherence of serial weighing: Full adherence (≥5 times: 43.2% (82/190) Partial adherence (2-4 times): 18.4% (35/190) Non-adherent (0-1 time): 19.5% (37/190) Unknown: 18.9% (36/190)
McGiveron et al., 2015[120] Bumps and Beyond	34-36	A vs. B Maternal Postpartum hemorrhage: Specific data NR; aOR 0.45, 95% CI, 0.21 to 0.96, p=NR	A vs. B, p=NR unless noted Maternal GWG, mean (SD): 4.5 kg (4.6) vs. 10.3 kg (4.4), p<0.001 GDM: Specific data NR; aOR 1.08, 95% CI, 0.37 to 3.15 HTN: Specific data NR; aOR 0.05, 95% CI, 0.01 to 0.22 Preeclampsia: Specific data NR; aOR 0.10, 95% CI, 0.01 to 0.90 Cesarean, emergency: Specific data NR; aOR 1.08, 95% CI, 0.53 to 2.22 Infant Preterm birth (37 weeks): Specific data NR; OR 0.78, 95% CI, 0.18 to 3.38	NR	97% (89/92) attended all sessions.

Appendix B Table 3. Included Studies – Outcomes and Harms

Author, Year Study Name	Weight Assessment Timepoint	Outcomes (Key Question 1)* A=Intervention B=Control	Outcomes (Key Question 2) A=Intervention B=Control	Outcomes (Key Question 3) A=Intervention B=Control	Adherence
Okesene-Gafa et al., 2019[121] HUMBA	36-Delivery	A vs. B Infant NICU: 11.8% (13/110) vs. 6.4% (7/110); aRR 1.76, 95% CI, 0.72 to 4.31, p=0.21 Stillbirth: 0.9% (1/112) vs. 2.6% (3/114)	A vs. B Maternal GWG, mean kg (SD): 9.7 (6.6) vs. 11.4 (6.3); aMD -1.76, 95% CI, -3.55 to 0.03, p=0.05 [n=100 vs. 101] Excess GWG per week (>0.27 kg/week): 73.8% (79/107) vs. 81.8% (90/110) GDM: 31.3% (30/96) vs. 23% (23/100); aRR 1.31, 95% CI, 0.83 to 2.09, p=0.25 Pregnancy-induced HTN: 7.3% (8/110) vs. 9% (10/111); aRR 0.78, 95% CI, 0.32 to 1.90, p=0.58 Cesarean: 34.8% (39/112) vs. 31.6% (36/114); aRR 1.11, 95% CI, 0.63 to 1.95, p=0.71 Cesarean, emergency: 12.5% (14/112) vs. 16.7% (19/114); aRR 0.71, 95% CI, 0.34 to 1.51, p=0.37 Infant LGA: 25.2% (28/111) vs. 22.5% (25/111), p=NR Preterm birth (<37 weeks): 9% (10/111) vs. 3.6% (4/111); aRR 2.59, 95% CI, 0.85 to 7.90, p=0.10	None related to intervention A vs. B Maternal EPDS score, % abnormal: 10.8% (9/83) vs. 8.6% (7/81); aRR 1.25, 95% CI, 0.49 to 3.21, p=0.64 STAI score, % abnormal: 8.2% (7/85) vs. 3.8% (3/79); aRR 2.17, 95% CI, 0.58 to 8.10, p=0.25 Infant SGA: 3.6% (4/111) vs. 3.6% (4/111), p=0.89	81% compliant with dietary intervention.
Olson et al., 2018[122] e-Moms	36-Delivery	NR	A vs. B, p=NR unless noted Maternal GWG, mean (SD): 13.73 kg (0.46) vs. 13.73 kg (0.45); aMD 0.10, 95% CI, -0.58 to 0.77, p>0.05 Excess GWG, percentage (SD): 48.1% (2) vs. 46.2% (2.4); aRR 1.09, 95% CI, 0.98 to 1.20, p>0.05 HTN by BMI normal weight: 3.3% vs. 3.3% HTN by BMI overweight and obese: 4.9% vs. 6.5% Preeclampsia by BMI normal weight: 3.8% vs. 3.8% Preeclampsia by BMI overweight and obese: 4.2% vs. 4.9% Cesarean by BMI normal weight: 21.8% vs. 15.8% Cesarean by BMI overweight and obese: 31.3% vs. 28.6% Infant Macrosomia by BMI normal weight: 6.6% vs. 12% Macrosomia by BMI overweight and obese: 11.1% vs. 11.3% Preterm birth (<37 weeks) by BMI normal weight: 3.1% vs. 5.4% Preterm birth (<37 weeks) by BMI overweight and obese: 6.7% vs. 7%	A vs. B Low birth weight (<2,500 g) by BMI normal weight: 3.5% vs. 4.6% Low birth weight (<2,500 g) by BMI overweight and obese: 5.2% vs. 5.4%	A and B vs. C Engaged with website at least once in each 45-day assessment period: 46% vs. 35% Median proportion of days logged in: 5.6% vs. 3.2% Completed satisfaction survey: 69% overall (no difference between groups)

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Author, Year Study Name	Weight Assessment Timepoint	Outcomes (Key Question 1)* A=Intervention B=Control	Outcomes (Key Question 2) A=Intervention B=Control	Outcomes (Key Question 3) A=Intervention B=Control	Adherence
Peccei et al., 2017[123]	36-Delivery	A vs. B, all p>0.05 Maternal Postpartum hemorrhage: 8.9% vs. 3.3%; OR 2.9, 95% CI, 0.8 to 10.2 Infant Shoulder dystocia: 2.2% vs. 3.3%; OR 0.7, 95% CI, 0.1 to 3.1 NICU: 3.9% vs. 3.3%; OR 1.2, 95% CI, 0.3 to 4.8	A vs. B, all p>0.05 Maternal GWG, mean (SD): 24.7 lbs (1.7) vs. 26.9 lbs (1.4) GWG within recommendations: 34.2% vs. 27.5%; OR 1.4, 95% CI, 0.8 to 2.4 GDM: 5.0% vs. 4.4%; OR 1.2, 95% CI, 0.3 to 3.9 HTN: 1.7% vs. 2.2%; OR 0.8, 95% CI, 0.1 to 4.6 Preeclampsia: 2.8% vs. 0% Cesarean: 24.0% vs. 21.8%; OR 1.2, 95% CI, 0.6 to 2.2 Infant LGA: 6.1% vs. 13.0%; OR 0.4, 95% CI, 0.2 to 1.0	A vs. B SGA: 6.1% vs. 3.3%; OR 1.9, 95% CI, 0.5 to 7.1	NR
Pelaez et al., 2019[124]	36-Delivery	NR	A vs. B Maternal GWG, mean (SD): 11.5 kg (3.5) vs. 13.7 kg (4.1), p=0.001; effect size 0.56 Excess GWG: 22% (22/100) vs. 34.3% (69/201), p=0.03 Excess GWG, baseline BMI ≥25 kg/m2: 42.9% (15/35) vs. 80% (40/50), p=0.001 GDM: 3% (3/100) vs. 6.5% (13/201) GDM, GWG within recommendations: 3.8% (3/78) vs. 3% (4/132) GDM, excess GWG: 0 vs. 15.9% (11/69), p=0.04 Cesarean: 17% (17/100) vs. 23.9% (48/201), p=0.02 Cesarean, GWG within recommendations: 17.9% (14/78) vs. 15.2% (20/132) Cesarean, excess GWG: 13.6% (3/22) vs. 40.6% (28/69), p=0.03 Infant Macrosomia (>4 kg): 0 vs. 5% (10/201), p=0.02 Macrosomia, GWG within recommendations: 0 vs. 0.8% (1/132) Macrosomia, excess GWG: 0 vs. 13% (9/69), p=0.07	NR	95.6%

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Author, Year Study Name	Weight Assessment Timepoint	Outcomes (Key Question 1)* A=Intervention B=Control	Outcomes (Key Question 2) A=Intervention B=Control	Outcomes (Key Question 3) A=Intervention B=Control	Adherence
Perales et al., 2015[125]	Delivery	NR	A vs. B Maternal GWG within recommendation: 53.2% vs. 32.7%, p=0.03 Excess GWG: 46.8% vs. 67.3%, p=0.03 Cesarean: 37.5% vs. 52%, p>0.05	None reported as related to study intervention A vs. B Note: CES-D Scale ≥16 indicates depression Maternal depression in third trimester: 17.8% vs. 47.2%, p=0.002 (mean CES-D 9.3 vs. 15.3); OR 0.24, 95% CI, 0.09 to 0.61 Depression by overweight: 16.2% vs. 47.7%, p=0.003 (mean CES-D 9 vs. 15.1); OR 0.21, 95% CI, 0.07 to 0.60 Depression by obese: 25% vs. 44.4%, p>0.05 Depression by GWG within recommendation: 8.7% vs. 62.5%, p<0.001; OR 0.06, 95% CI, 0.01 to 0.34 Depression by excess GWG: 30% vs. 42.9%, p>0.05	97.2% of those in Group A attended at least 80% of sessions.

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Author, Year Study Name	Weight Assessment Timepoint	Outcomes (Key Question 1)* A=Intervention B=Control	Outcomes (Key Question 2) A=Intervention B=Control	Outcomes (Key Question 3) A=Intervention B=Control	Adherence
Petrella et al., 2014[126]	Delivery	NR	A vs. B Maternal GWG, mean (SD): 8.8 kg (6.5) vs. 10.4 kg (5.0), p>0.05 Excess GWG: 33.3% vs. 60.7%, adjusted p=0.01 GWG by BMI 25-29.9 kg/m^2, mean (SD): 11.3 kg (7.8) vs. 11.3 kg (3.0), p>0.05 GWG by BMI ≥30 kg/m^2: 6.7 kg (4.3) vs. 10.1 kg (5.6), p=0.047 GWG within recommendations: 66.7% vs. 39.3%; p=0.03 GWG within recommendations by BMI 25-29.9 kg/m^2: 53% vs. 63%, p>0.05 GWG within recommendations by BMI ≥30 kg/m^2: 78% vs. 30%, p=0.003 GDM: 23% vs. 57%, adjusted p=0.01 HTN: 3% vs. 25%, p=0.011 Cesarean: 33.1% vs. 32.1%, p>0.05 Infant Preterm birth (time NR): 0% vs. 36%, p=0.002	NR	NR

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Author, Year Study Name	Weight Assessment Timepoint	Outcomes (Key Question 1)* A=Intervention B=Control	Outcomes (Key Question 2) A=Intervention B=Control	Outcomes (Key Question 3) A=Intervention B=Control	Adherence
Phelan et al., 2011[128] Fit For Delivery	36-Delivery	NR	A vs. B Maternal GWG by BMI normal weight, mean (SD): 15.3 kg (4.4) vs. 16.2 kg (4.6) GWG by BMI overweight and obese, mean (SD): 14.7 kg (6.9) vs. 15.1 kg (7.5) GWG within recommendations by BMI normal weight: 46% vs. 35% GWG within recommendations by BMI Overweight and obese: 21% vs. 24% Excess GWG by BMI normal weight: 40% vs. 52%; OR 0.8, 95% CI, 0.2 to 0.87, p=0.003 Excess GWG by BMI overweight and obese: 67% vs. 61%, p>0.05 PPWR (6 months) by BMI normal weight, mean (SD): 2.1 kg (4.7) vs. 3.3 kg (3.5), p>0.05 PPWR (6 months) by BMI overweight and obese, mean (SD): 3.7 kg (5.9) vs. 4.3 kg (6.2), p>0.05 GDM by BMI normal weight: 8.8% vs. 6.5%, p=NR GDM by BMI overweight and obese: 13.6% vs. 8.1%, p=NR HTN by BMI normal weight: 3% vs. 12%; OR 0.21, 95% CI, 0.05 to 0.96, p=0.003 HTN by BMI overweight and obese: 21% vs. 13%; OR 1.80, 95% CI, 0.71 to 4.60, p>0.05 Preeclampsia by BMI normal weight: 3% vs. 7%, p=NR Preeclampsia by BMI overweight and obese: 21% vs. 13%, p=NR Cesarean by BMI normal weight: 27% vs. 27%, p=NR Cesarean by BMI overweight and obese: 41% vs. 49%, p=NR Cesarean, normal weight vs. overweight and obese: OR 0.38, 95% CI, 0.26 to 0.74, p=0.004 Infant Macrosomia by BMI normal weight: 7% vs. 3%, p>0.05 Macrosomia by BMI overweight and obese: 17% vs. 16%, p>0.05 Macrosomia, normal weight vs. overweight and obese: OR 0.26, 95% CI, 0.06 to 0.99, p=0.05 Preterm birth (<36 weeks), BMI normal weight: 7% vs. 14%, p>0.05 Preterm birth (<36 weeks), BMI overweight and obese: 12% vs. 8%, p>0.05	"The intervention had no adverse effects on incidences of pregnancy and birth complications." A vs. B Low birth weight (<2,500 g) by BMI normal weight: 4% vs. 5%, p>0.05 Low birth weight (<2,500 g) by BMI overweight and obese: 6% vs. 5%, p>0.05	NR
Phelan et al., 2014[127]	Same as Phelan et al., 2011	Same as Phelan et al., 2011	A vs. B Maternal PPWR (12 months): 1.4 kg (6.3) vs. 3.0 kg (5.7), adjusted p>0.05	NR	NR

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Author, Year Study Name	Weight Assessment Timepoint	Outcomes (Key Question 1)* A=Intervention B=Control	Outcomes (Key Question 2) A=Intervention B=Control	Outcomes (Key Question 3) A=Intervention B=Control	Adherence
Phelan et al., 2018[130] Healthy Beginnings / Comienzo Saludables	34-36	NR	A vs. B Maternal GWG, mean (SD): 9.4 kg (6.9) vs. 11.2 kg (7.0), p=0.03 GWG within recommendations: 28.7% vs. 23.4%, adjusted OR 1.34, 95% CI, 0.75 to 2.39, p>0.05 Excess GWG: 41.1% vs. 53.9%, adjusted OR 0.57, 95% CI, 0.33 to 0.95, p=0.03 GDM: 17.8% vs. 18.8%, OR 0.9, 95% CI, 0.46 to 1.96, p>0.05 HTN: 4% vs. 5.6%, OR 0.67, 95% CI, 0.18 to 2.28, p>0.05 Preeclampsia: 8% vs. 6.4%, OR 1.29, 95% CI, 0.48 to 3.58, p>0.05 Cesarean: 36.8% vs. 31.2%, OR 1.24, 95% CI, 0.73 to 2.13, p>0.05 Infant Preterm birth (<36 weeks): 3.2% vs. 3.9%, OR 0.76, 95% CI, 0.18 to 2.98, p>0.05 Macrosomia: 7.4% vs. 7.8%, OR 0.95, 95% CI, 0.34 to 2.63, p>0.05	A vs. B Low birth weight (<2,500 g): 8.3% vs. 6.1%, OR 1.84, 95% CI, 0.62 to 5.83, p>0.05	Attendance at sessions: mean (SD) 6.5 (2.5) visits.
Phelan et al., 2019[129]	Same as Phelan et al., 2018	Same as Phelan et al., 2018	A vs. B Maternal PPWR (baseline pregnancy weight to 12 months), mean (95% CI): 1.5 kg (0.3 to 2.6) vs. 1.4 kg (0.3 to 2.6), adjusted p=0.97 PPWR (prepregnancy weight to 12 months), mean (95% CI): 3.1 kg (1.8 to 4.4) vs. 3.3 kg (2.0 to 4.6), adjusted p=0.82 At or below baseline pregnancy weight: 38% (49/129) vs. 39.1% (50/128), adjusted p=0.56 At or below prepregnancy weight: 31.8% (41/129) vs. 29.7% (38/128), adjusted p=0.98	NR	83.7% (215/257) attended 12-month visit.

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Author, Year Study Name	Weight Assessment Timepoint	Outcomes (Key Question 1)* A=Intervention B=Control	Outcomes (Key Question 2) A=Intervention B=Control	Outcomes (Key Question 3) A=Intervention B=Control	Adherence
Polley et al., 2002[131]	36-Delivery	NR	A vs. B Maternal GWG by BMI normal weight, mean (SD): 15.4 kg (7.1) vs. 16.4 kg (4.8), p>0.05 GWG by BMI overweight and obese, mean (SD): 13.6 kg (7.2) vs. 10.1 kg (6.2), p<0.001 GWG by race, black vs. white: 14.3 kg vs. 14.1 kg, p>0.05 GWG within recommendations by BMI normal weight: 36.7% vs. 25.8%, p>0.05 GWG within recommendations by BMI overweight and obese: 22.2% vs. 36.4%, p>0.05 Excess GWG by BMI normal weight: 33.3% vs. 58.1%, p<0.05 Excess GWG by BMI overweight and obese: 59.3% vs. 31.8%, p>0.05 PPWR (mean 8 weeks [7.1]) by BMI normal weight, mean (SD): 4.4 kg (5.4) vs. 6.2 kg (4.5), p>0.05 PPWR (mean 8 weeks [7.1]) by BMI overweight and obese, mean (SD): 3.6 kg (5.6) vs. 0.3 kg (7), p>0.05 PPWR by race, black vs. white: 4.3 kg vs. 3.3 kg, p>0.05 GDM by BMI normal weight: 0% vs. 6%, p=NR GDM by BMI overweight and obese: 7% vs. 5%, p=NR HTN by BMI normal weight: 7% vs. 13%, p=NR HTN by overweight and obese: 15% vs. 18%, p=NR Preeclampsia by BMI normal weight: 0% vs. 0% Preeclampsia by BMI overweight and obese: 7% vs. 18%, p=NR Cesarean by BMI normal weight: 7% vs. 13%, p=NR Cesarean by overweight and obese: 7% vs. 27%, p=NR Infant, no *p* values calculated Macrosomia by BMI normal weight: 3% vs. 0% Macrosomia by BMI overweight and obese: 0% vs. 0% Preterm birth (<36 weeks) by BMI normal weight: 17% vs. 6% Preterm birth (<36 weeks) by BMI overweight and obese: 7% vs. 14%	A vs. B Low birth weight (<2,500 g) by BMI normal weight: 13% vs. 10% Low birth weight (<2,500 g) by BMI overweight and obese: 4% vs. 9%	NR
Rauh et al., 2013[132] FeLIPO	36-Delivery	NR	A vs. B, all p>0.05 unless noted Maternal GWG, mean (SD): 14.1 kg (4.1) vs. 15.6 kg (5.8); aMD -1.7, 95% CI, -3.0 to -0.3, adjusted p=0.049 Excess GWG: 38.2% vs. 59.5%; aOR 0.5, 95% CI, 0.3 to 0.9, p=0.03 PPWR (4 months), mean (SD): 2.1 kg (4.3) vs. 3.3 kg (5.1); aMD -1.4, 95% CI, -2.7 to -0.2 GDM: 5.4% vs. 12.2%; aOR 0.5, 95% CI, 0.2 to 1.4 Cesarean: 30% vs. 42%; aOR 0.6, 95% CI, 0.4 to 1.2 Infant LGA: 6.4% vs. 8.9%; aOR 0.8, 95% CI, 0.3 to 2.3 Preterm birth (not defined): 2.6% vs. 6.3%; aOR 0.3, 95% CI, 0.1 to 1.2	A vs. B SGA: 3.8% vs. 3.8%; aOR 1.0, 95% CI, 0.2 to 4.9	NR

Appendix B Table 3. Included Studies – Outcomes and Harms

Author, Year Study Name	Weight Assessment Timepoint	Outcomes (Key Question 1)* A=Intervention B=Control	Outcomes (Key Question 2) A=Intervention B=Control	Outcomes (Key Question 3) A=Intervention B=Control	Adherence
Rauh et al., 2015[133]	Same as Rauh et al., 2013	Same as Rauh et al., 2013	A vs. B Maternal PPWR (12 months), mean (SD): 0.2 kg (3.6) vs. 0.8 kg (5.7), aMD -1.0, 95% CI, -3.2 to 1.2, p>0.05 Adjusted estimate of effect for 1 kg increase in GWG on weight retention at 12 months postpartum: 0.4 kg, 95% CI, 0.2 to 0.5, p<0.001 Infant Weight (10th to 12th month), mean (SD): 9,382 g (931) vs. 9,736 g (999), aMD -257, 95% CI, (-578 to 65), p>0.05	NR	NR
Redman et al., 2017[134] SmartMoms	34-36	NR	A vs. B vs. C Maternal GWG, mean (SD): 8 kg (1.3) vs. 10 kg (1.3) vs. 12.8 kg (1.5), p=0.04 for A vs. C and A vs. B, p>0.05 for B vs. C Excess GWG: 56% vs. 58% vs. 84.6%, p=0.03 for A vs. C, p=0.04 for B vs. C	None	A: 60.8% (in person group) B: 76.5 (remote group) difference: p=0.049
Renault et al., 2014[58] TOP	36-Delivery	NR	A vs. B vs. C Maternal GWG, median (range): 8.6 kg (-9.6 to 34.1) vs. 9.4 kg (-3.4 to 28.2) vs. 10.9 kg (-4.4 to 28.7); A+B vs. C, p=0.01, A vs. C, p=0.01, B vs. C, p=0.04, A vs. B, p>0.05 Excess GWG: 45% vs. 51% vs. 63%, p=0.01 GDM: 3.8% vs. 1.6% vs. 5.2%, p>0.05 HTN: 3.8% vs. 3.2% vs. 6.7%, p>0.05 Preeclampsia: 1.5% vs. 4% vs. 2.2%, p>0.05 Cesarean, emergency: 11% vs. 22% vs. 24%, p=0.02 Cesarean, planned: 14% vs. 19% vs. 14%, p>0.05 Infant Macrosomia: 22% vs. 30% vs. 25%, p>0.05 LGA: 6.9% vs. 6.4% vs. 6.7%, p>0.05 Preterm birth (<37 weeks): 3.1% vs. 6.4% vs. 4.5%, p>0.05	A vs. B vs. C SGA: 5.4% vs. 3.2% vs. 1.5%, p>0.05	NR
Ronnberg et al., 2014[135]	Delivery	NA	A vs. B, all p>0.05 unless noted Maternal GWG, mean (SD): 14.2 kg (4.5) vs. 15.3 kg (5.4), p=0.03; MD 1.12, 95% CI, 0.12 to 2.12 GWG below recommendations, multiparous only: 22% vs. 12%, p=0.03 GWG within recommendations: 40.1% vs. 33.5% Excess GWG: 41.1% vs. 50% Excess GWG by BMI normal weight: 35% vs. 42% Excess GWG by BMI overweight: 56% vs. 81% Excess GWG by BMI obese: 58% vs. 61%	NR	NR

Appendix B Table 3. Included Studies – Outcomes and Harms

Author, Year Study Name	Weight Assessment Timepoint	Outcomes (Key Question 1)* A=Intervention B=Control	Outcomes (Key Question 2) A=Intervention B=Control	Outcomes (Key Question 3) A=Intervention B=Control	Adherence
Ruiz et al., 2013[138]	36-Delivery	NR	A vs. B Maternal GWG, mean (SD): 11.9 kg (3.8) vs. 13.2 kg (4.3), adjusted p<0.001 GWG by BMI normal weight, mean (SD): 12.3 kg (3.6 vs. 13.8 kg (4.1), adjusted p<0.001 GWG by BMI overweight and obese, mean (SD): 11.1 kg (4.3) vs. 11.6 kg (4.2), p>0.05 GWG within recommendation: 44.8% vs. 42.1%, p>0.05 GWG within recommendation by BMI normal weight: 46.4% vs. 46%, p>0.05 GWG within recommendation by BMI overweight and obese: 41.1% vs. 31%, p>0.05 Excess GWG: 23.8% vs. 32%; aOR 0.63, 95% CI, 0.46 to 0.85, p=0.002 Excess GWG by BMI normal weight: 12.6% vs. 22.1%; aOR 0.51, 95% CI, 0.33 to 0.77, p=0.002 Excess GWG by BMI overweight and obese: 49.3% vs. 58.9%; aOR 0.65, 95% CI, 0.43 to 1.13, p>0.05 Excess GWG among high (university level) education: OR 6.9, 95% CI, 0.56 to 0.83, p<0.001 Excess GWG by maternal age: Specific data NR; p>0.05 GDM: 3.3% vs. 6.2%; aOR 0.52, 95% CI, 0.28 to 0.98, p=0.04 GDM by BMI normal weight: 2.1% vs. 5.1%, p>0.05 GDM by BMI overweight and obese: 6.2% vs. 9.3%, p>0.05 HTN: 2.7% vs. 6.2%; aOR 0.41, 95% CI, 0.21 to 0.79, p=0.008 HTN by BMI normal weight: 1.5% vs. 5.7%; aOR 0.24, 95% CI, 0.09 to 0.65, p=0.005 HTN by BMI overweight and obese: 5.5% vs. 7.8%, p>0.05 Cesarean: 19.3% vs. 19.6%, p>0.05 Cesarean by BMI normal weight: 16.5% vs. 18.7%, p>0.05 Cesarean by BMI overweight and obese: 25.9% vs. 22.1% Infant Macrosomia: 2.1% vs. 5%; aOR 0.35, 95% CI, 0.17 to 0.75, p=0.007 Macrosomia by BMI normal weight: 2.4% vs. 4%, p>0.05 Macrosomia by BMI overweight and obese: 1.4% vs. 9.3%; aOR 0.14, 95% CI, 0.03 to 0.66, p=0.01 Preterm birth (<36 weeks): 1.9% vs. 1%, p>0.05 Preterm birth by BMI normal weight: 2.3% vs. 0.6%, p>0.05 Preterm birth by BMI overweight and obese: 2.7% vs. 1.5%, p>0.05	A vs. B vs. C Low birth weight (<2,500 g): 2% vs. 4.8%, p>0.05 Low birth weight by BMI normal weight: 5.7% vs. 4.3%, p>0.05 Low birth weight by BMI overweight and obese: 3.4% vs. 6.2%, p>0.05	NR

Appendix B Table 3. Included Studies – Outcomes and Harms

Author, Year Study Name	Weight Assessment Timepoint	Outcomes (Key Question 1)* A=Intervention B=Control	Outcomes (Key Question 2) A=Intervention B=Control	Outcomes (Key Question 3) A=Intervention B=Control	Adherence
Sagedal et al., 2017[139] Norwegian Fit For Delivery	Delivery	A vs. B, all p>0.05 Maternal Postpartum hemorrhage (≥500 mL): 20.3% vs. 19.3%; OR 1.06, 95% CI, 0.71 to 1.59 Perineal tear (3rd or 4th degree): 3.5% vs. 3.5%; OR 1.0, 95% CI, 0.39 to 2.55 Infant Shoulder dystocia: 0.9% vs. 1.9% NICU: 12.8% vs. 12.9%; OR 0.99, 95% CI, 0.61 to 1.61 Stillbirth: 0% vs. 0.3%	A vs. B Maternal GWG, mean (SD): 14.4 kg (6.2) vs. 15.8 kg (5.7), p=0.009 GWG by BMI normal weight, mean (SD): 14.7 kg (5.1) vs. 15.8 kg (5.4), p=0.04 GWG by BMI overweight, mean (SD): 15.3 kg (7.4) vs. 16.7 kg (7.1), p>0.05 GWG by BMI obese, mean (SD): 10.3 kg (9) vs. 13.4 kg (5.8), p>0.05 Excess GWG: 41.6% vs. 50.0%; OR 0.71, 95% CI, 0.51 to 1.0, p>0.05 GDM: 11.8% vs. 9.1%; OR 1.33, 95% CI, 0.77 to 2.32, p>0.05 Preeclampsia: 3.4% vs. 5.2%; OR 0.65, 95% CI, 0.29 to 1.47, p>0.05 Cesarean, emergency: 10.1% vs. 9.8%; OR 1.04, 95% CI, 0.61 to 1.78, p>0.05 Cesarean, elective: 2.7% vs. 2.4%; OR 1.03, 95% CI, 0.63 to 1.68, p>0.05 Infant Macrosomia: 11.8% vs. 14%; OR 0.82, 95% CI, 0.50 to 1.35, p>0.05 LGA: 2.4% vs. 3.7%; OR 0.63, 95% CI, 0.24 to 1.64, p>0.05 Preterm birth (34-37 weeks): 4.7% vs. 4.4%; OR 1.08, 95% CI, 0.50 to 2.33, p>0.05	A vs. B SGA: 10.5% vs. 9.2%; OR 1.16, 95% CI, 0.68 to 2.0, p>0.05	NR
Sagedal et al., 2017b[140]	Same as Sagedal et al., 2017	Same as Sagedal et al., 2017	A vs. B Maternal PPWR (12 months): 0.66 kg (5.5) vs. 1.42 kg (5), p>0.05	NR	NR
Seneviratne et al., 2016[141]	36-Delivery	A vs. B, all p<0.05 Maternal Severe postpartum hemorrhage: 8% (3/37) vs. 14% (5/37) Perineal tear: 22% (6/27) vs. 35% (10/29) Infant RDS: 13% (5/37) vs. 5% (2/37) NICU: 8% (3/37) vs. 8% (3/37) Fetal death in utero: 3% (1/37) vs. 3% (1/37)	A vs. B, all p<0.05 Maternal GWG, mean (SD): 12 kg (5.3) vs. 13.2 kg (5.8) GDM: 11% (4/37) vs. 5% (2/37) Gestational HTN: 3% (1) vs. 0 Preeclampsia: 3% (1/37) vs. 3% (1/37) Cesarean: 47% (18/37) vs. 35% (13/37) Infant Macrosomia (>4 kg): 26% (10/37) vs. 19% (7/37) LGA: 24% (9/37) vs. 11% (4/37) Preterm birth (<37 weeks): 5% (2/37) vs. 3% (1/37)	None related to intervention SGA: 11% (4/37) vs. 8% (3/37) Low birth weight (<2,500 g): 3% (1/37) vs. 3% (1/37)	33% completed more than 30/67 sessions (range 0-85%, mean 572 min); 52% of exercise was at moderate intensity.

Appendix B Table 3. Included Studies – Outcomes and Harms

Author, Year Study Name	Weight Assessment Timepoint	Outcomes (Key Question 1)* A=Intervention B=Control	Outcomes (Key Question 2) A=Intervention B=Control	Outcomes (Key Question 3) A=Intervention B=Control	Adherence
Simmons et al., 2017[142] DALI Lifestyle	34-36	NR	A vs. B vs. C vs. D Maternal GWG, mean (SD): 6.5 kg (3.8) vs. 8 kg (4.7) vs. 8.5 kg (5) vs. 8.8 kg (4.7); HE+PA vs. Control aMD -2.02, 95% CI, -3.58 to -0.45, p<0.05 GWG within recommendations: 40% vs. 28% vs. 28% vs. 24%; HE+PA vs. Control aOR 2.13, 95% CI, 1.05 to 4.33, p<0.05 GDM: 32% vs. 44% vs. 34% vs. 37%; aOR 0.80, 95% CI, 0.43 to 1.49, p>0.05 Infant LGA: 9% vs. 15% vs. 14% vs. 18%; aOR 0.47, 95% CI, 0.19 to 1.18, p>0.05	A vs. B vs. C vs. D SGA: 8% vs. 10% vs. 6% vs. 6%; aOR 1.51, 95% CI, 0.46 to 4.94, p>0.05	NR
Skouteris et al., 2016[143] HIPP	34-36	NR	A vs. B Maternal GWG, mean (SD): 12.8 kg (6.7) vs. 12.1 kg (6.8), p>0.05 GWG by BMI under- or normal weight, mean (SD): 14.4 kg (4.0) vs. 13.5 kg (4.8), p>0.05 GWG by BMI overweight and obese, mean (SD): 10.5 kg (8.8) vs. 9.8 kg (8.6), p>0.05 GWG within recommendations: 36.9% vs. 33.6%, adjusted p>0.05 Excess GWG: 40.8% vs. 36.3%, adjusted p>0.05 Cesarean, emergency: 14.3% vs. 5.3%, p=NR Cesarean, elective: 4.8% vs. 12%, p=NR Infant Preterm birth (time NR): 3.1% vs. 1.5%, p=NR	A vs. B Note: EPDS >13 indicates depression, DASS >5 indicates anxiety Depression (mean 33 weeks), mean (SD): 5.5 (4.2) vs. 6.3 (4.5); regression coefficient -0.50, 95% CI, -1.5 to 0.5, p>0.05 Anxiety (mean 33 weeks), mean (SD): 4.8 (4.9) vs. 5.5 (5.2); regression coefficient 0.04, 95% CI, -1.12 to 1.2, p>0.05	NR
Smith et al., 2016[144]	34-36	NR	A vs. B, all p>0.05 Maternal GWG, mean (SD): 13.6 kg (5.6) vs. 11.7 kg (5.1) GWG within recommendation: 27.3% vs. 33.3% Excess GWG: 68.2% vs. 52.4%	NR	NR

Appendix B Table 3. Included Studies – Outcomes and Harms

Author, Year Study Name	Weight Assessment Timepoint	Outcomes (Key Question 1)* A=Intervention B=Control	Outcomes (Key Question 2) A=Intervention B=Control	Outcomes (Key Question 3) A=Intervention B=Control	Adherence
Thomson et al., 2016[148] Delta Healthy Sprouts	Delivery	NR	A vs. B, all p>0.05 Maternal GWG within recommendations: 10.3% vs. 25.6% Excess GWG: 61.5% vs. 53.5% HTN: 2.9% vs. 7.1% Preeclampsia: 0% vs. 2% Cesarean, emergency: 16.7% vs. 10% Cesarean, elective: 8.3% vs. 13.3% Infant Macrosomia: 8.3% vs. 6.7% LGA: 12.5% vs. 6.7% Preterm birth (<37 weeks): 8.3% vs. 16.7%, p=0.44	A vs. B SGA: 20.8% vs. 6.7% Low birth weight (<2,500 g): 20.8% vs. 6.7%	NR
Thomson et al., 2018[147]	Same as Thomson et al., 2016	Same as Thomson et al., 2016	A vs. B Infant Overweight at 12 months: 75% (18/24) vs. 73.3% (22/30) Overweight survival time, median (95% CI): 3.6 months (1.3 to 10.7) vs. 2.9 months (1.4 to 6.4), p=0.82 Rapid infant weight gain: 75% (18/24) vs. 73.3% (22/30) RIWG survival time, median (95% CI): 6 months (3.6 to 10.2) vs. 7 months (3.9 to 8.8), p=0.68	NR	88% (A) and 83% (B) adherence; mean 10 postnatal visits.

Appendix B Table 3. Included Studies – Outcomes and Harms

Author, Year Study Name	Weight Assessment Timepoint	Outcomes (Key Question 1)* A=Intervention B=Control	Outcomes (Key Question 2) A=Intervention B=Control	Outcomes (Key Question 3) A=Intervention B=Control	Adherence
Van Horn et al., 2018[149] MOMFIT	34-36	NR	A vs. B Maternal GWG, mean (SD): 10 kg (6) vs. 12 kg (6), adjusted p=0.02 GWG, BMI overweight, mean (SD): 26 lbs (12) vs. 27 lbs (11), p=0.49 GWG, BMI obese, mean (SD): 20 lbs (12) vs. 26 lbs (14), p=0.01 Excess GWG: 68.6% (96/140) vs. 84.4% (119/141), adjusted p=0.004 Excess GWG, BMI overweight: 79% (50/63) vs. 86% (55/64), p=0.33 Excess GWG, BMI obese: 60% (46/77) vs. 83% (64/77), p=0.001 GDM: 5.3% (7/133) vs. 7.1% (9/127), adjusted p=0.41 GDM, BMI overweight: 2% (1/50) vs. 0, p=0.99 GDM, BMI obese: 8% (6/75) vs. 13% (9/69), p=0.35 Cesarean: 39.6% (55/140) vs. 27% (37/137), adjusted p=0.01 Cesarean, BMI overweight: 33% (21/64) vs. 30% (18/60), p=0.60 Cesarean, BMI obese: 44% (34/77) vs. 25% (19/76), p=0.01 See Appendix 4 for cesarean indications Infant LGA: 5.8% (8/130) vs. 8.8% (12/121), adjusted p=0.51 LGA, BMI overweight: 0 vs. 2% (1/50), p=0.50 LGA, BMI obese: 10% (8/80) vs. 15% (11/73), p=0.43 Preterm birth (<37 weeks): 4.3% (6/139) vs. 8.8% (12/136), p=0.13 Preterm birth, BMI overweight: 3% (2/67) vs. 11% (7/64), p=0.08 Preterm birth, BMI obese: 5% (4/80) vs. 7% (5/71), p=0.70	A vs. B Infant SGA: 18% (25/130) vs. 19.9% (27/121), adjusted p=0.61 SGA, BMI overweight: 26% (16/62) vs. 21% (13/62), p=0.56 SGA, BMI obese: 12% (9/75) vs. 19% (14/74), p=0.23	70.1% reported weight weekly
Vesco et al., 2014[150] Healthy Moms	2 weeks postpartum	A vs. B Infant NICU: 4% vs. 11%, p>0.05	A vs. B, all p>0.05 unless noted Maternal GWG, mean (SD): 5.0 kg (4.1) vs. 8.4 kg (4.7), MD -3.4, 95% CI, -5.1 to -1.8, p<0.001; Cohen's d 0.69 Excess GWG by rate of weight gain per week: 44% vs. 82% GDM: 11% vs. 12%; OR 0.87, 95% CI, 0.28 to 2.78 HTN and preeclampsia: 9% vs. 10%; OR 0.85, 95% CI, 0.24 to 2.96 Cesarean: 38% vs. 45%; OR 0.74, 95% CI, 0.59 to 3.34 Infant Macrosomia: 11% vs. 22%; OR 0.42, 95% CI, 0.14 to 1.18 LGA: 9% vs. 26%; OR 0.28, 95% CI, 0.09 to 0.84, p=0.02 Preterm birth (<37 weeks): 7.1% vs. 3.4%	A vs. B Infant SGA: 5% vs. 7%; OR 0.76, 95% CI, 0.11 to 4.76	NR

Appendix B Table 3. Included Studies – Outcomes and Harms

Author, Year Study Name	Weight Assessment Timepoint	Outcomes (Key Question 1)* A=Intervention B=Control	Outcomes (Key Question 2) A=Intervention B=Control	Outcomes (Key Question 3) A=Intervention B=Control	Adherence
Vesco et al., 2016[151]	Same as Vesco et al., 2014	Same as Vesco et al., 2014	A vs. B Maternal PPWR (12 months): -1.4 kg vs. -0.9 kg; aMD -0.5 kg, 95% CI, -4.0 to 3.1), p>0.05 Infant Weight (12 months): 9.8 kg (0.9) vs. 10 kg (1.2); aMD 0.02, 95% CI, -0.37 to 0.41, p>0.05 Weight across time: aMD -0.2 kg, 95% CI, -0.38 to -0.02, p=0.03	NR	NR
Vinter et al., 2011[59] LiP	34-36	A vs. B Infant NICU: 14% vs. 14.3%, p>0.05 Neonatal death: 1.3% vs. 0.65%, p>0.05	A vs. B, all p<0.05 unless noted Maternal GWG, median (range): 7.0 kg (4.7 to 10.6) vs. 8.6 kg (5.7 to 11.5), p=0.01 GWG within recommendations: 64.6% vs. 53.4% Excess GWG: 35.4% vs. 46.6% GDM: 6% vs. 5.2% HTN and preeclampsia: 15.4% vs. 18.2% Cesarean, emergency: 14.7% vs. 18.2% Cesarean, planned: 12% vs. 7.1% Infant Macrosomia: 32% vs. 25.3% LGA: 15.4% vs. 11.7%	NR	A: 92% attended all 4 dietary counseling sessions, 98% completed at least 3 Mean attendance at 20 aerobic sessions was 10.4 hours, and 56% attended at least half of the sessions. 77.5% undertook additional activities. B: 65% undertook "leisure time sporting activities"
Vinter et al., 2014[152]	Same as Vinter et al., 2011	Same as Vinter et al., 2011	A vs. B Maternal PPWR (6 months), >0 kg: 46% vs. 57%, p>0.05 PPWR (6 months), >5 kg: 17% vs. 23%, p>0.05 PPWR, GWG within recommendations vs. excess GWG, median (IQR): -0.7 kg (-3.3 to 2.3) vs. 1.5 (-0.6 to 5.9), p<0.001 PPWR, nulliparous vs. multiparous, median (IQR): 0.95 kg (-1.75 to 4.2) vs. -0.4 kg (-3.2 to 2.9), p=0.02	NR	NR

Appendix B Table 3. Included Studies – Outcomes and Harms

Author, Year Study Name	Weight Assessment Timepoint	Outcomes (Key Question 1)* A=Intervention B=Control	Outcomes (Key Question 2) A=Intervention B=Control	Outcomes (Key Question 3) A=Intervention B=Control	Adherence
Tanvig et al., 2014[146]	Same as Vinter et al., 2011	NR	A vs. B, all p>0.05 Infant Weight (2.8 years), mean (95% CI): 14.7 kg (14.3 to 15.1) vs. 14.4 kg (14.1 to 14.8) BMI (2.8 years), mean (95% CI): 16.4 kg/m^2 (16.1 to 16.7) vs. 16.1 kg/m^2 (15.8 to 16.4) BMI z-score (2.8 years): 0.06 (0.17 to 0.29) vs. -0.18 (-0.43 to 0.05) BMI overweight and obese (2.8 years): 10.9% vs. 6.7%	NR	NR
Tanvig et al., 2015[145]	Same as Vinter et al., 2011	NR	A vs. B Infant Birth weight association with BMI z-score: adjusted regression coefficient 0.46, 95% CI, 0.31 to 0.59, p<0.001	NR	NR
Willcox et al., 2017[153] txt4two	34-36	NR	A vs. B Maternal GWG, mean (SD): 11.0 kg (5.9) vs. 13.6 kg (5.6); adjusted coefficient -2.86, 95% CI, -5.58 to -0.14, p=0.039 Excess GWG: 47% vs. 61%, p>0.05	NR	96% responded to texts 31% joined Facebook page
Wolff et al., 2008[154]	34-36	NR	A vs. B Maternal GWG, mean (SD): 6.6 kg (5.5) vs. 13.3 kg (7.5); MD 6.7, 95% CI, 2.6 to 10.8 kg, p=0.002 GDM: 0% vs. 10%, p=NR PPWR (4 weeks): -4.5 kg vs. 2.4 kg; MD 6.9, 95% CI, 2.5 to 11.2, p=0.003 HTN: 4% vs. 15%, p=NR Preeclampsia: 0% vs. 4%, p=NR Cesarean: 9% vs. 11%, p=NR	NR	NR

* Outcomes abstracted into Key Question (KQ) 1-3 columns as specified by workplan. SGA and depression and anxiety reported as outcomes, not harms related to intervention, but included in KQ3 column per the finalized research workplan.

Abbreviations: aMD = adjusted mean difference; aOR = adjusted odds ratio; aRR = adjusted risk ratio; BDI-II = Beck Depression Inventory II; BMI = body mass index; CES-D = Center for Epidemiologic Studies Depression scale; CI = confidence interval; DASS = Depression Anxiety Stress Scale; EPDS = Edinburgh Postnatal Depression Scale; EGWG = excess gestational weight gain; ESTEEM = Effect of Simple, Targeted Diet in Pregnant Women with Metabolic Risk Factors on Pregnancy Outcomes; ETIP = Exercise Training in Pregnancy; FFQ = Food Frequency Questionnaire; GDM = gestational diabetes mellitus; GWG = gestational weight gain; HADS = Hospital Anxiety and Depression Scale; HE = healthy eating; HTN = hypertension; HUMBA = Healthy Mums and Babies; IQR = interquartile range; IOM = Institute of Medicine; LGA= large for gestational age; LIFT= Lifestyle Interventions For Two; MCS = Mental Component Summary; MD = mean difference; MMT = Mindful MAMAS Training; MOMFIT = Maternal Offspring Metabolics Family Intervention Trial; NA = not applicable; NICU = neonatal intensive care unit; NR = not reported; OPTIMISE = not defined; OR = odds ratio; PA = physical activity; PCS = Physical Component Summary; POPS2 = Pregnancy Outcome Prediction Study; PPWR = postpartum weight retention; RDS = respiratory distress syndrome; RR= relative risk; SD = standard deviation; SE = standard error; SEM = standard error of the mean; SGA = small for gestational age; SPAS = Social Physique Anxiety Scale; STAI = State Trait Anxiety Index; SWEP = Study Water Exercise Pregnant; TOP = Treatment of Obese Pregnant Women.

Appendix C Table 1. Quality Assessment of Randomized Controlled Trials

Author, Year Study Name	Randomization adequate?	Allocation concealment adequate?	Groups similar at baseline?	Eligibility criteria specified?	Outcome assessors masked?	Care provider masked?	Patient masked?	Attrition and withdrawals reported?	Important loss to followup?	Analyze people in the groups in which they were randomized?	Funding source reported?	Quality Rating
Aguilar-Cordero et al., 2019[71] SWEP	Yes	Yes	Yes	Yes	Unclear	No	No	Yes	No	Yes	Yes	Fair
Al Wattar et al., 2019[72] ESTEEM	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No	No	Yes	Fair
Altazan et al., 2019[73] Expecting Success / SmartMoms	Unclear	Yes	Yes	Yes	Yes	No	No	Yes	No	Yes	Yes	Fair
Althuizen et al., 2013[74] New Life (style)	Yes	Unclear	Yes	Yes	Yes	No	No	Yes	No	Yes	Yes	Good
Asbee et al., 2009[75]	Yes	Yes	Yes	Yes	No	No	No	Yes	No	Yes	Yes	Fair
Assaf-Balut et al., 2017[76]	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No	Yes	Yes	Good
Bacchi et al., 2018[77]	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	Fair
Barakat et al., 2012[78]	Yes	Yes	Yes	Yes	No	No	No	Yes	No	Yes	Yes	Fair
Barakat et al., 2014[81]	Yes	Yes	Yes	Yes	No	No	No	Yes	No	Yes	Yes	Fair
Barakat et al., 2016[80]	Yes	Yes	Yes	Yes	No	No	No	Yes	No	Yes	Yes	Fair
Barakat et al., 2018[79]	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	No	Fair
Barakat et al., 2019[82]	Yes	Yes	Yes	Yes	No	No	No	Yes	No	Yes	No	Fair
Bogaerts et al., 2013[83]	Yes	Unclear	Yes	Yes	No	No	No	Yes	No	Yes	Yes	Fair
Brownfoot et al., 2016[84]	Yes	Yes	Yes	Yes	No	No	No	Yes	No	Yes	Yes	Fair
Bruno et al., 2017[85]	Yes	Yes	Unclear	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Fair
Cahill et al., 2018[86] PreGO	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No	Yes	Yes	Good
Haire-Joshu et al., 2019[103]	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	Fair
Daley et al., 2015[88]	Yes	Yes	No	Yes	No	No	No	Yes	No	Yes	Yes	Fair
Daley et al., 2019[89] POPS2	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Fair
Daly et al., 2017[90] Healthy eating, Exercise and Lifestyle Trial	Yes	Yes	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	Yes	Yes	Fair
Dodd et al., 2014[56] LIMIT	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No	Yes	Yes	Good

Appendix C Table 1. Quality Assessment of Randomized Controlled Trials

Author, Year Study Name	Randomization adequate?	Allocation concealment adequate?	Groups similar at baseline?	Eligibility criteria specified?	Outcome assessors masked?	Care provider masked?	Patient masked?	Attrition and withdrawals reported?	Important loss to followup?	Analyze people in the groups in which they were randomized?	Funding source reported?	Quality Rating
Dodd et al., 2018[91]	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No	Yes	Yes	Good
Dodd et al., 2019[92] OPTIMISE	Yes	Unclear	Yes	Yes	Yes	No	No	Yes	No	Yes	Yes	Good
Gallagher et al., 2018[94] LIFT	Unclear	Unclear	Yes	Yes	Yes	No	No	Yes	No	Yes	Yes	Fair
Garnaes et al., 2016[97] ETIP	Yes	Yes	Yes	Yes	Unclear	No	No	Yes	No	Yes	Yes	Fair
Garnaes et al., 2017[98]	Yes	Yes	Yes	Yes	Unclear	No	No	Yes	No	Yes	Yes	Fair
Garnaes et al., 2018[96]	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No	Yes	Yes	Good
Garnaes et al., 2019[95]	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Fair
Gesell et al., 2015[99] Madre Sana, Bebé Sano / Healthy Mother, Healthy Baby	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No	Yes	Yes	Fair
Guelfi et al., 2016[101]	Yes	Yes	Yes	Yes	Unclear	No	No	Yes	No	Yes	Yes	Fair
Haakstad et al., 2011[102]	Yes	Yes	Yes	Yes	Unclear	No	No	Yes	Yes	Yes	No	Fair
Harrison et al., 2013[104] HeLP-her	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Good
Harrison et al., 2014[105]	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Good
Hawkins et al., 2014[106] Estudio Vida	Yes	Unclear	Yes	Yes	No	No	No	Yes	No	Yes	Yes	Fair
Herring et al., 2016[108]	Yes	Yes	Yes	Yes	Unclear	No	No	Yes	No	Yes	Yes	Fair
Herring et al., 2017[107]	Yes	Yes	Yes	Yes	Unclear	No	No	Yes	No	Yes	Yes	Fair
Hui et al., 2012[110]	Yes	Unclear	Yes	Yes	No	No	No	Yes	Yes	No	Yes	Fair
Hui et al., 2014[111]	Yes	Unclear	Yes	Yes	No	No	No	Yes	No	Yes	Yes	Fair
Koivusalo et al., 2016[114] RADIEL	Yes	Yes	Yes	Yes	No	No	No	Yes	No	Yes	Yes	Fair

Appendix C Table 1. Quality Assessment of Randomized Controlled Trials

Author, Year Study Name	Randomization adequate?	Allocation concealment adequate?	Groups similar at baseline?	Eligibility criteria specified?	Outcome assessors masked?	Care provider masked?	Patient masked?	Attrition and withdrawals reported?	Important loss to followup?	Analyze people in the groups in which they were randomized?	Funding source reported?	Quality Rating
Huvinen et al., 2018[112]	Yes	Yes	Yes	Yes	No	No	No	Yes	No	Yes	Yes	Fair
Rono et al., 2018a[137]	Yes	Yes	Yes	Yes	Unclear	Unclear	Unclear	Yes	Yes	Yes	Yes	Fair
Rono et al., 2018b[136]	Yes	Yes	Yes	Yes	Unclear	Unclear	Unclear	Yes	No	Yes	Yes	Fair
Kunath et al., 2019[115] GeliS	Yes	Yes	Yes	Yes	Unclear	No	No	Yes	No	Yes	Yes	Fair
Hoffman et al., 2019[109]	Yes	Yes	Yes	Yes	Unclear	No	No	Yes	No	Yes	Yes	Fair
LeBlanc et al., 2020[116] PREPARE	Yes	Yes	Yes	Yes	Yes	Unclear	Unclear	Yes	No	Yes	Yes	Good
Luoto et al., 2011[117] NELLI	Yes	Yes	Yes	Yes	No	No	No	Yes	No	Yes	Yes	Good
Kinnunen et al., 2012[113]	Yes	Yes	Yes	Yes	No	No	No	Yes	No	Yes	Yes	Good
Magriples et al., 2015[118] Centering Pregnancy Plus	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Fair
McCarthy et al., 2016[119] FFF	Yes	Yes	Yes	Yes	Unclear	No	No	Yes	No	Unclear	Yes	Fair
Okesene-Gafa et al., 2019[121] HUMBA	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Good
Olson et al., 2018[122] e-Moms	Yes	Unclear	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Fair
Peccei et al., 2017[123]	Yes	Yes	Yes	Yes	No	No	No	Yes	No	Yes	Yes	Fair
Pelaez et al., 2019[124]	Yes	Unclear	Yes	Yes	No	No	No	Yes	Yes	No	Yes	Fair
Perales et al., 2015[125]	Yes	Yes	Yes	Yes	No	Unclear	Unclear	Yes	No	Yes	Yes	Good
Petrella et al., 2014[126]	Yes	Yes	Yes	Yes	No	No	No	Yes	No	Yes	No	Fair
Phelan et al., 2011[128] Fit For Delivery	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No	Yes	Yes	Fair
Phelan et al., 2014[127]	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No	Yes	Yes	Fair
Phelan et al., 2018[130] Healthy Beginnings / Comienzo Saludables	Yes	Unclear	Yes	Yes	Yes	No	No	Yes	No	No	Yes	Fair

Appendix C Table 1. Quality Assessment of Randomized Controlled Trials

Author, Year Study Name	Randomization adequate?	Allocation concealment adequate?	Groups similar at baseline?	Eligibility criteria specified?	Outcome assessors masked?	Care provider masked?	Patient masked?	Attrition and withdrawals reported?	Important loss to followup?	Analyze people in the groups in which they were randomized?	Funding source reported?	Quality Rating
Phelan et al., 2019[129]	Yes	No	Yes	Yes	Yes	No	No	Yes	No	Yes	Yes	Fair
Polley et al., 2002[131]	Unclear	Unclear	Yes	Yes	Unclear	No	No	Yes	No	Yes	Yes	Fair
Rauh et al., 2013[132] FeLIPO	Yes	Yes	No	Yes	No	No	No	Yes	No	Unclear	Yes	Fair
Rauh et al., 2015[133]	Yes	Yes	No	Yes	No	No	No	Yes	No	Unclear	Yes	Fair
Redman et al., 2017[134] SmartMoms	Yes	No	Yes	Yes	No	No	No	No	NR	Yes	Yes	Fair
Renault et al., 2014[58] TOP	Yes	Yes	Yes	Yes	No	No	No	Yes	No	Yes	Yes	Good
Ronnberg et al., 2014[135]	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	Fair
Ruiz et al., 2013[138]	Yes	Unclear	Yes	Yes	Unclear	No	No	Yes	Yes	Yes	Yes	Fair
Sagedal et al., 2017[139] Norwegian Fit For Delivery	Yes	Yes	Yes	Yes	Yes	Unclear	Unclear	Yes	No	Yes	Yes	Good
Sagedal et al., 2017b[140]	Yes	Yes	Yes	Yes	Yes	Unclear	Unclear	Yes	No	Yes	Yes	Good
Seneviratne et al., 2016[141]	Yes	Yes	Yes	Yes	No	No	No	Yes	No	Yes	Yes	Good
Simmons et al., 2017[142] DALI Lifestyle	Yes	Yes	Yes	Yes	Yes	Unclear	No	Yes	No	Yes	Yes	Good
Skouteris et al., 2016[143] HIPP	Yes	Yes	Yes	Yes	Yes	Unclear	Unclear	Yes	Yes	Yes	Yes	Fair
Smith et al., 2016[144]	Yes	Yes	Yes	Yes	No	No	No	Yes	No	No	Yes	Fair
Thomson et al., 2016[148] Delta Healthy Sprouts	Yes	Unclear	Yes	Yes	Unclear	No	No	Yes	No	Yes	Yes	Fair
Thomson et al., 2018[147]	Yes	Unclear	Yes	Yes	No	Unclear	No	Yes	Yes	Yes	Yes	Fair
Van Horn et al., 2018[149] MOMFIT	Yes	Yes	No	Yes	Yes	No	Unclear	Yes	No	Yes	Yes	Fair
Vesco et al., 2014[150] Healthy Moms	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No	Yes	Yes	Good
Vesco et al., 2016[151]	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No	Yes	Yes	Good

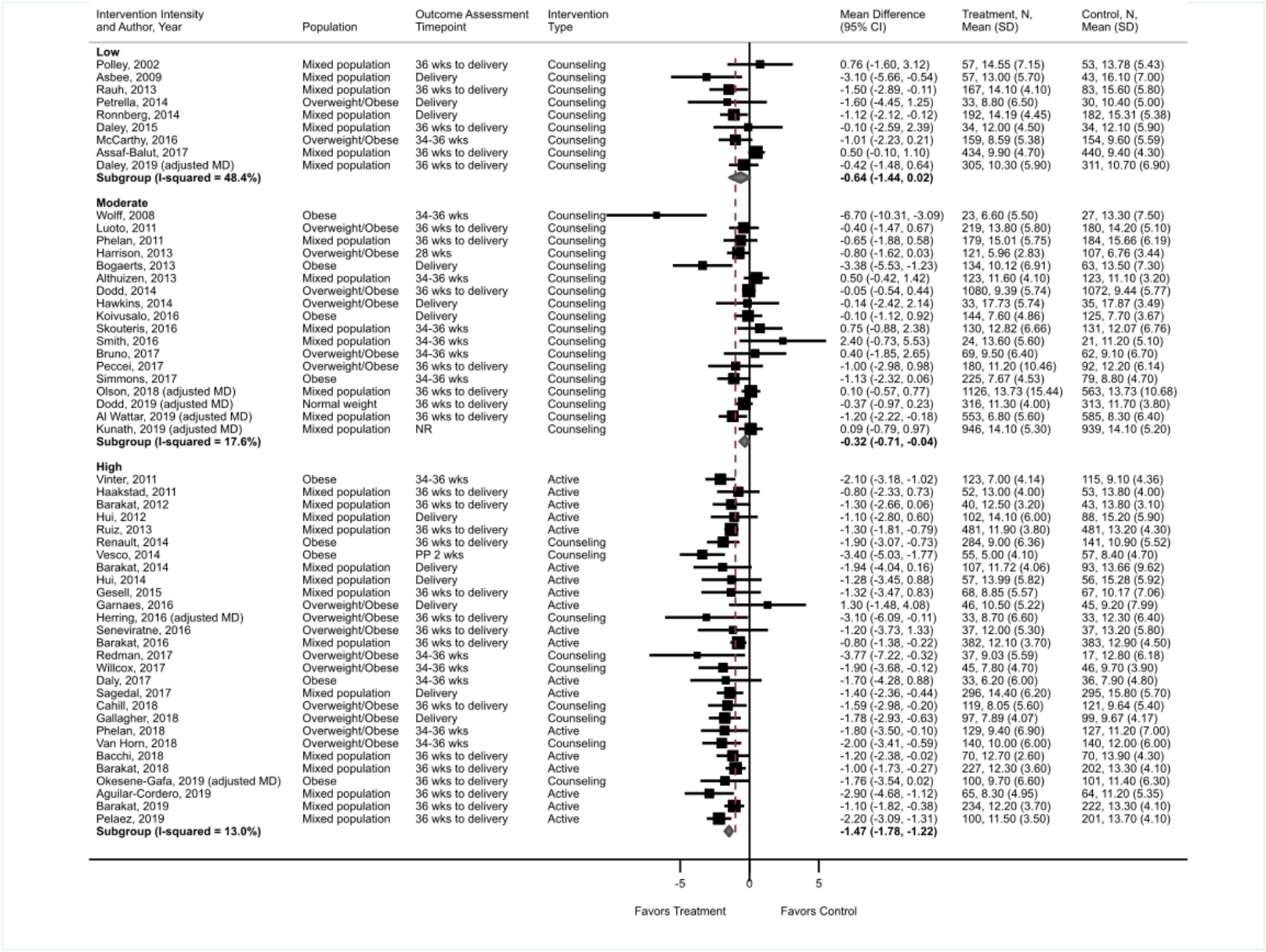
Appendix C Table 1. Quality Assessment of Randomized Controlled Trials

Author, Year Study Name	Randomization adequate?	Allocation concealment adequate?	Groups similar at baseline?	Eligibility criteria specified?	Outcome assessors masked?	Care provider masked?	Patient masked?	Attrition and withdrawals reported?	Important loss to followup?	Analyze people in the groups in which they were randomized?	Funding source reported?	Quality Rating
Vinter et al., 2011[59] LiP	Yes	Yes	Yes	Yes	No	No	No	Yes	No	No	Yes	Fair
Vinter et al., 2014[152]	Yes	Yes	Yes	Yes	No	No	No	Yes	No	No	Yes	Fair
Tanvig et al., 2014[146]	Yes	Yes	Yes	Yes	No	No	No	Yes	No	No	Yes	Fair
Tanvig et al., 2015[145]	Yes	Yes	Yes	Yes	No	No	No	Yes	No	No	Yes	Fair
Willcox et al., 2017[153] txt4two	Yes	Yes	Unclear	Yes	Unclear	No	No	Yes	No	Yes	Yes	Fair
Wolff et al., 2008[154]	Unclear	Unclear	Yes	Yes	Unclear	Yes	No	Yes	Yes	Yes	Yes	Fair

Appendix C Table 2. Quality Assessment of Controlled Clinical Trials

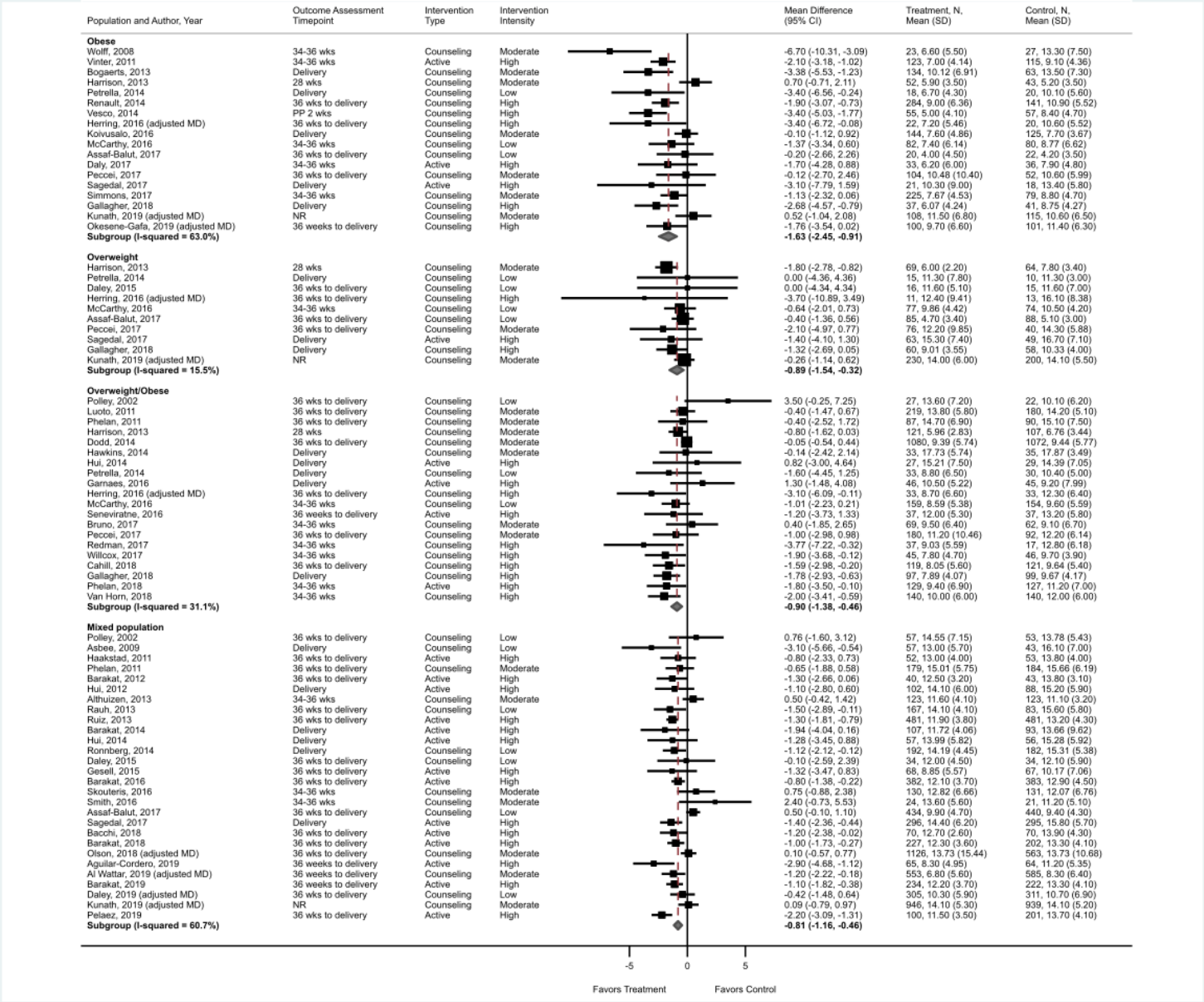
Author, Year Study Name	Random or consecutive patient enrollment?	Groups comparable at baseline?	Accurate methods to find potential confounders and outcomes?	Outcome assessors and/or data analysts blinded?	Reporting of attrition?	Appropriate statistical analyses on potential confounders?	Important loss to followup?	Outcomes pre-specified and defined?	Funding source reported?	Quality Rating
Claesson et al., 2010[83]	Yes	Yes	Yes	Unclear	Yes	Yes	Yes	Yes	Yes	Fair
Epel et al., 2019[89] MMT	Yes	Yes	Yes	Unclear	Yes	Yes	No	Yes	Yes	Good
Gray-Donald et al. 2000[96]	Yes	Yes	Yes	Unclear	Unclear	Yes	Unclear	Yes	Yes	Fair
McGiveron et al., 2015[115] Bumps and Beyond	Yes	No	Yes	Unclear	Yes	Yes	No	Yes	Yes	Fair

Appendix D Figure 1. Meta-Analysis of Trials: Mean Gestational Weight Gain by Intervention Intensity



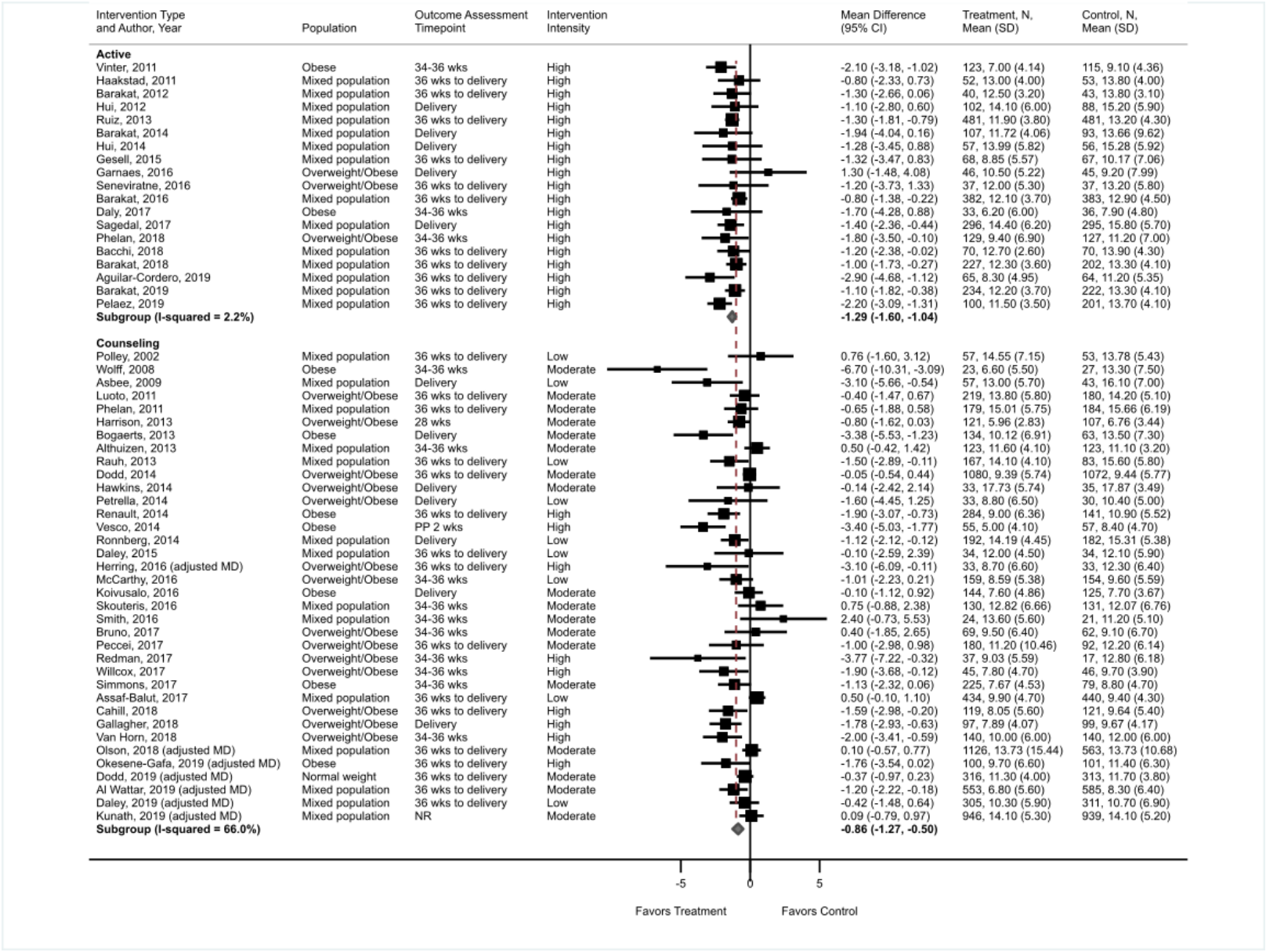
Abbreviations: CI = confidence interval; I-squared = test for heterogeneity using profile-likelihood estimate; N = number; NR = not reported; SD = standard deviation.

Appendix D Figure 2. Meta-Analysis of Trials: Mean Gestational Weight Gain by BMI Category



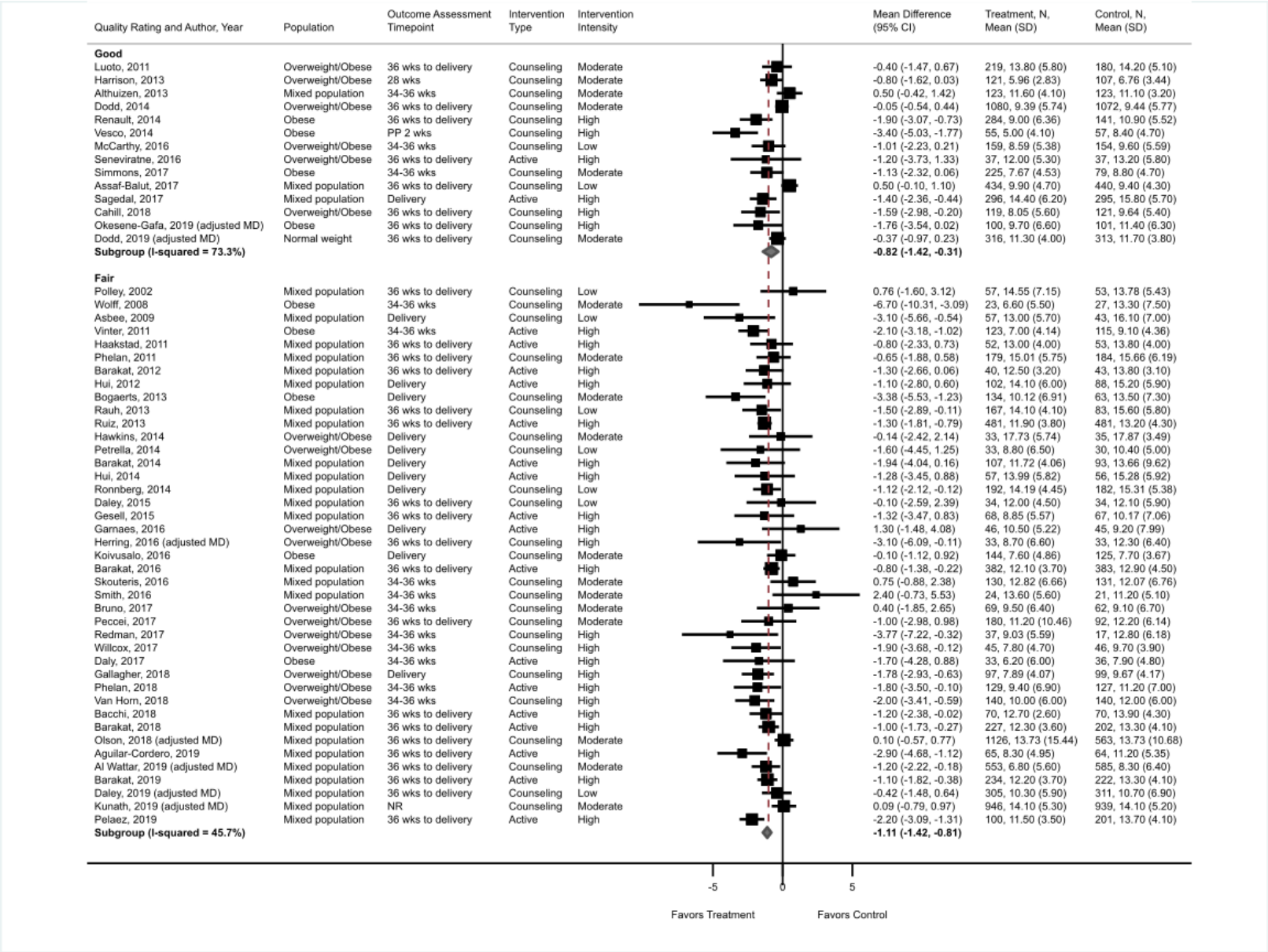
Abbreviations: CI = confidence interval; I-squared = test for heterogeneity using profile-likelihood estimate; N = number; NR = not reported; SD = standard deviation.

Appendix D Figure 3. Meta-Analysis of Trials: Mean Gestational Weight Gain by Intervention Type



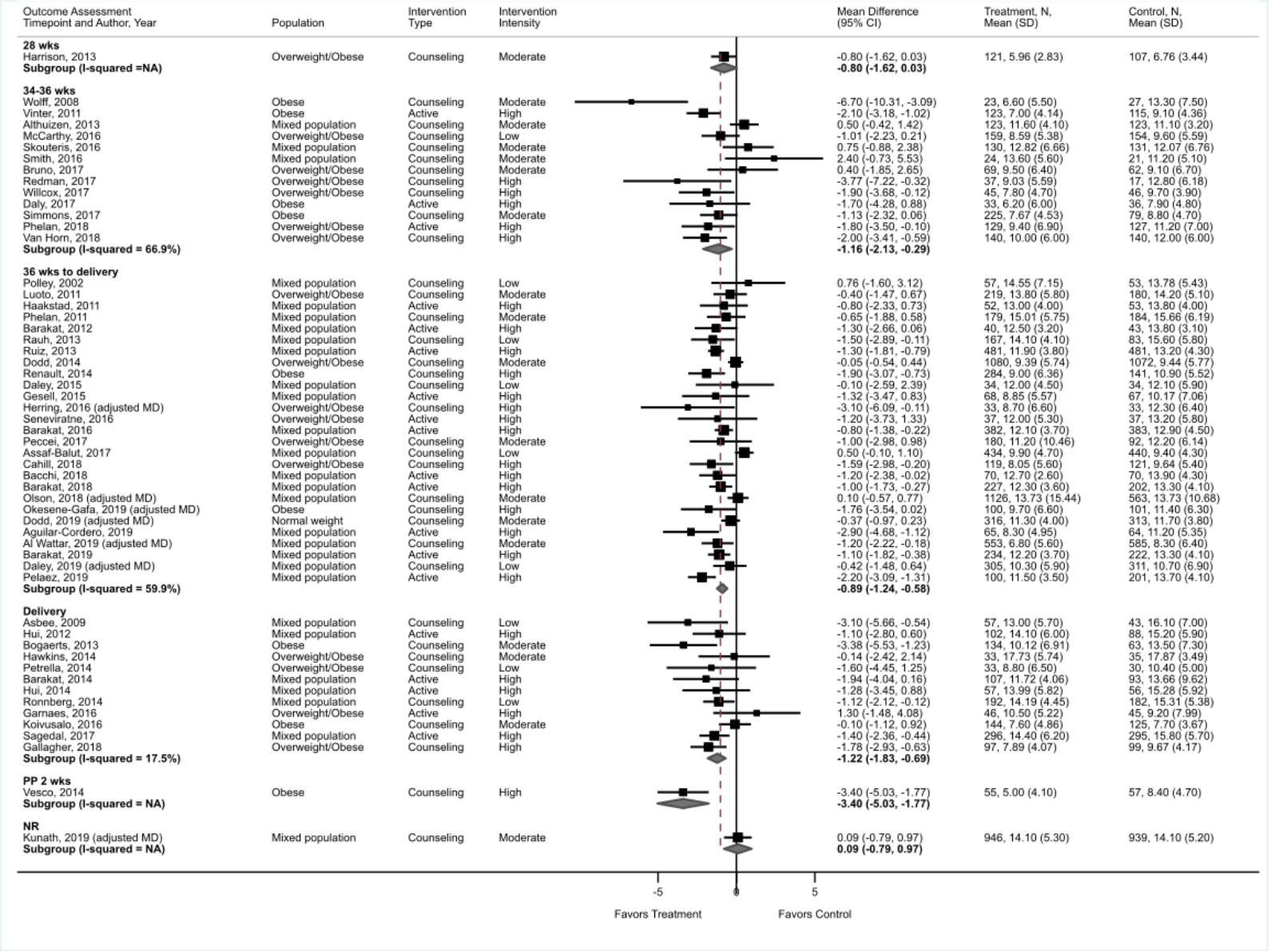
Abbreviations: CI = confidence interval; I-squared = test for heterogeneity using profile-likelihood estimate; N = number; NR = not reported; SD = standard deviation.

Appendix D Figure 4. Meta-Analysis of Trials: Mean Gestational Weight Gain by Intervention Quality



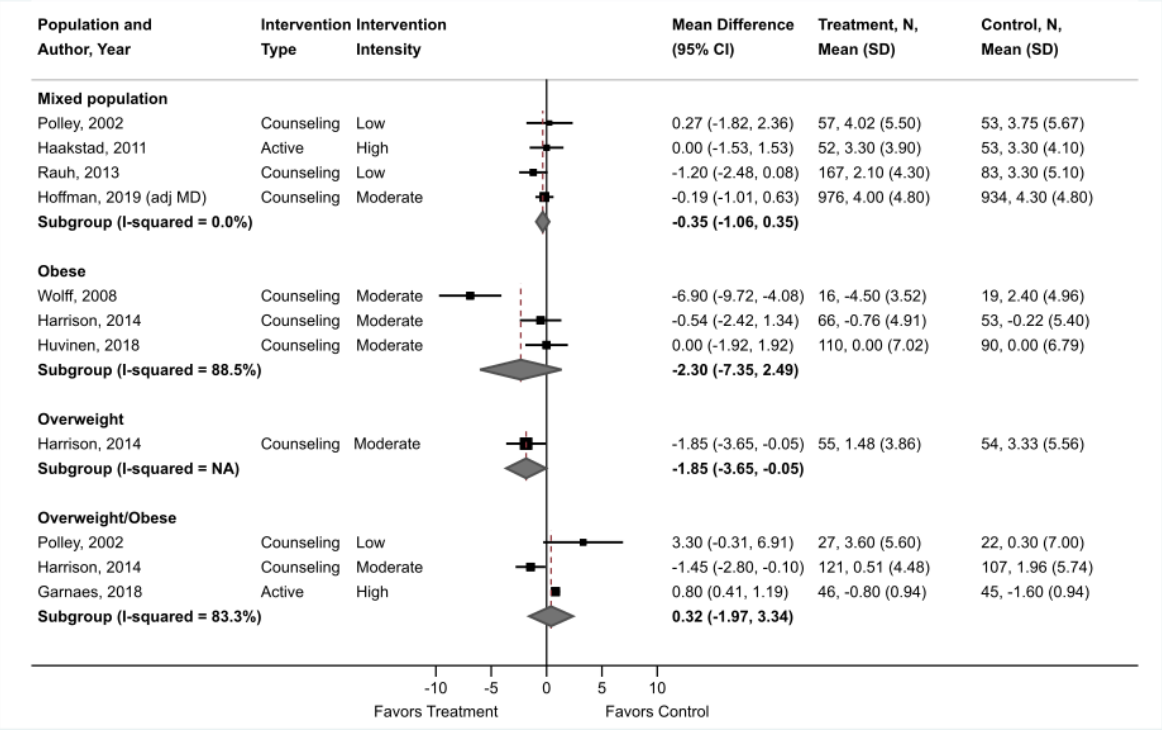
Abbreviations: CI = confidence interval; I-squared = test for heterogeneity using profile-likelihood estimate; N = number; NR = not reported; SD = standard deviation.

Appendix D Figure 5. Meta-Analysis of Trials: Mean Gestational Weight Gain by Outcome Assessment Timepoint



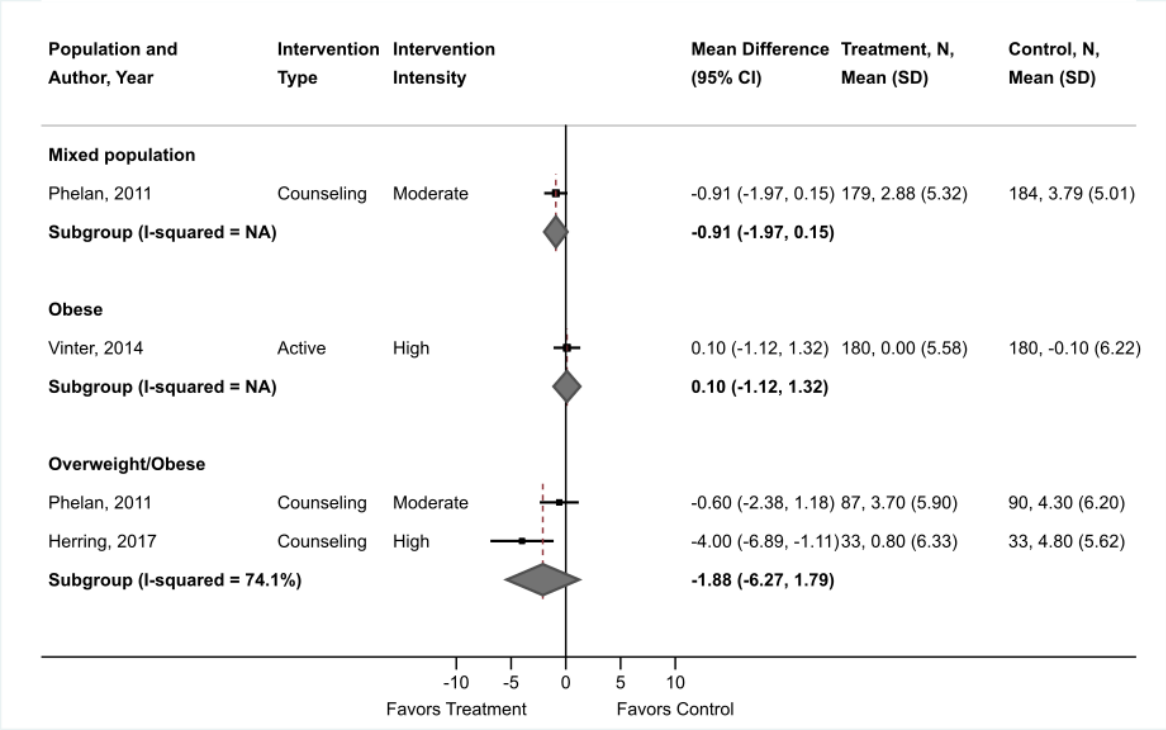
Abbreviations: CI = confidence interval; I-squared = test for heterogeneity using profile-likelihood estimate; N = number; NA= not applicable; NR = not reported; SD = standard deviation.

Appendix D Figure 6. Meta-Analysis of Trials: Mean Postpartum Weight Retention by BMI – Less Than 6 Months



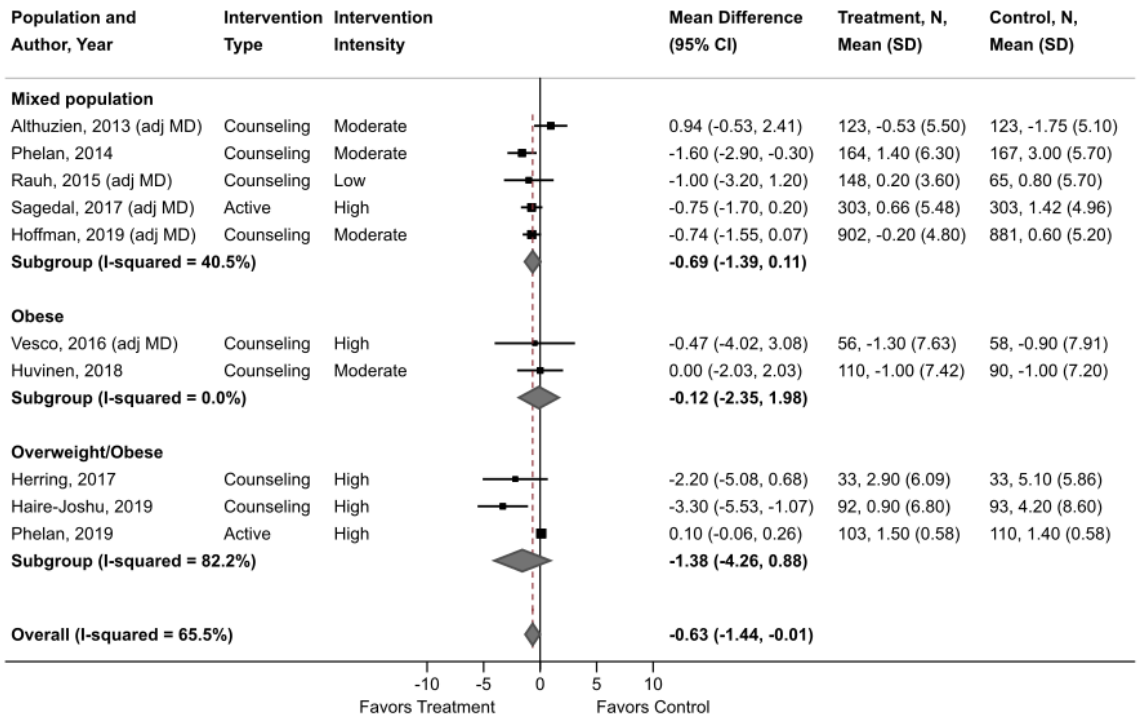
Abbreviations: CI = confidence interval; I-squared = test for heterogeneity using profile-likelihood estimate; NA = not applicable.

Appendix D Figure 7. Meta-Analysis of Trials: Mean Postpartum Weight Retention by BMI – 6 Months



Abbreviations: CI = confidence interval; I-squared = test for heterogeneity using profile-likelihood estimate; NA = not applicable.

Appendix D Figure 8. Meta-Analysis of Trials: Mean Postpartum Weight Retention by BMI – 12 Months



Abbreviations: CI = confidence interval; I-squared = test for heterogeneity using profile-likelihood estimate.

Appendix E Table 1. Summary of Included Studies

Author, Year Study Name	Study Design N	Setting	Population BMI Category	Intervention Type; Intensity	Estimated Time	Description Intervention Comparison	Maternal Health Outcomes	Infant Health Outcomes	Weight Outcomes	Harms	Quality Rating
Aguilar-Cordero et al., 2019[71] SWEP	RCT N=140	One university-affiliated aquatic facility Granada, Spain	Mixed	Active; High intensity	1 hour classes 3x per week (planned 54 classes), weeks 20-37	A. Intervention: supervised aquatic exercise classes from weeks 20 to 37. B. Comparison: usual prenatal care.			X	X	Fair
Al Wattar et al., 2019[72] ESTEEM	RCT N=1,218	5 inner-city maternity units London and Birmingham, UK	Mixed	Counseling; Moderate intensity	3 in-person sessions, 2 phone calls	A. Intervention: in-person sessions; initial individual consultation with dietician, group sessions (20 weeks and 28 weeks), phone calls from team (24 weeks and 32 weeks). Provided mixed nuts (30 g/day walnuts, hazelnuts, almonds) and extra-virgin olive oil (0.5 L/week). Fact sheets on olive oil and mixed nuts, educational presentations, weekly individual food portion plan. B. Comparison: usual prenatal care.	X	X	X	X	Fair

Appendix E Table 1. Summary of Included Studies

Author, Year Study Name	Study Design N	Setting	Population BMI Category	Intervention Type; Intensity	Estimated Time	Description Intervention Comparison	Maternal Health Outcomes	Infant Health Outcomes	Weight Outcomes	Harms	Quality Rating
Altazan et al., 2019[73] Expecting Success / SmartMoms	RCT N=54	Clinic or smartphone Baton Rouge, LA	Overweight and obese	Counseling; High intensity	18 lessons (time NR)	A. Intervention: in-person SmartMoms intervention, received dietary intake advice, exercise advice, weight graph created from dynamic GWG models to determine the trimester specific increase in energy intake required to adhere to the IOM recommendations. Structured intervention consisted of lessons and behavior modification counseling weekly (13-24 weeks), then biweekly (week 25 to delivery). B. Intervention: remote SmartMoms Intervention, same as above intervention, but delivered via intensity-matched phone app at least once weekly. C: Comparison: usual prenatal care.			X		Fair
Althuizen et al., 2013[74] New Life(style)	RCT N=246	Eight midwifery clinics, Netherlands	Mixed	Counseling; Moderate intensity	30-min phone call; three 15-min in person; one 15-min phone call	A. Intervention: counseling modules on healthy lifestyle, personalized feedback on weight gain. B. Comparison: usual prenatal care.	X	X	X		Good
Asbee et al., 2009[75]	RCT N=144	One prenatal care center, Charlotte, North Carolina	Mixed	Counseling; Low intensity	NR - one initial study visit	A. Intervention: counseling on healthy lifestyle, recommended physical activity, personalized feedback on weight gain. B. Comparison: usual prenatal care	X		X		Fair

Appendix E Table 1. Summary of Included Studies

Author, Year Study Name	Study Design N	Setting	Population BMI Category	Intervention Type; Intensity	Estimated Time	Description Intervention Comparison	Maternal Health Outcomes	Infant Health Outcomes	Weight Outcomes	Harms	Quality Rating
Assaf-Balut et al., 2017[76]	RCT N=1,000	One hospital-affiliated clinic, Madrid, Spain	Mixed	Counseling; Low intensity	1 hour initial study visit	A. Intervention: lifestyle guidance, emphasis on including healthy fats (olive oil and pistachio consumption). B. Comparison: usual prenatal care, emphasis on restricting fat.	X	X	X	X	Good
Bacchi et al., 2018[77]	RCT N=140	One primary care obstetric clinic, Buenos Aires, Argentina	Mixed	Active; High intensity	55-60 min 3x per week	A. Intervention: aerobic and aquatic exercises per ACOG guidelines. B. Comparison: usual prenatal care.		X	X	X	Fair
Barakat et al., 2012[78]	RCT N=100	One primary care obstetric clinic, Madrid, Spain	Mixed	Active; High intensity	35-45 min 3x per week	A. Intervention: aerobic and aquatic exercise. B. Comparison: usual prenatal care.	X		X		Fair
Barakat et al., 2014[81]	RCT N=251	One maternity care hospital, Madrid, Spain	Mixed	Active; High intensity	55-60 min 3x per week	A. Intervention: aerobic exercise. B. Comparison: usual prenatal care.	X	X	X		Fair
Barakat et al., 2016[80]	RCT N=840	One hospital, Madrid, Spain	Mixed	Active; High intensity	55-60 min 3x per week	A. Intervention: aerobic exercise per ACOG guidelines. B. Comparison: usual prenatal care.	X	X	X	X	Fair
Barakat et al., 2018[79]	RCT N=429	2 primary care medical centers Madrid, Spain	Mixed	Active; High intensity	55-60 min 3x per week	A. Intervention: structured, supervised exercise classes from gestational week 9-11 to week 38-39. B. Comparison: usual prenatal care.		X	X		Fair

Appendix E Table 1. Summary of Included Studies

Author, Year Study Name	Study Design N	Setting	Population BMI Category	Intervention Type; Intensity	Estimated Time	Description Intervention Comparison	Maternal Health Outcomes	Infant Health Outcomes	Weight Outcomes	Harms	Quality Rating
Barakat et al., 2019[82]	RCT N=456	2 tertiary care hospitals Madrid, Spain	Mixed	Active; High intensity	55-60 min 3x per week	A. Intervention: structured, supervised exercise classes from gestational week 8-10 to week 38-39; final motivational talk on importance of active pregnancy. B. Comparison: usual prenatal care.	X	X	X		Fair
Bogaerts et al., 2013[83]	RCT N=205	Three hospital-based antenatal units, Belgium	Obese	Counseling; Moderate intensity	Four 1.5-2 hour in person groups	A. Intervention A: motivational lifestyle intervention sessions and brochure about nutritional advice and physical activity during pregnancy, with information to limit excessive gestational weight gain. B. Intervention B: brochure only. C. Comparison: usual prenatal care.	X		X	X	Fair
Brownfoot et al., 2016[84]	RCT N=782	One tertiary obstetric hospital, Melbourne, Australia	Mixed	Counseling; Low intensity	NR – during visits	A. Intervention: weight recording at each prenatal visit with IOM guidelines prominently displayed; discussion with clinician about appropriate weight gain according to IOM guidelines. B. Comparison: usual prenatal care, did not have access to scales or weighing themselves as part of the visit.	X	X	X	X	Fair

Appendix E Table 1. Summary of Included Studies

Author, Year Study Name	Study Design N	Setting	Population BMI Category	Intervention Type; Intensity	Estimated Time	Description Intervention Comparison	Maternal Health Outcomes	Infant Health Outcomes	Weight Outcomes	Harms	Quality Rating
Bruno et al., 2017[85]	RCT N=191	One university hospital, Modena, Italy	Overweight and obese	Counseling; Moderate intensity	1 hour initial study visit; four follow-up visits (time NR)	A. Intervention: counselling session at enrollment with dietician for prescribed personalized dietary plan. B. Comparison: counselling session at enrollment with dietitian for general recommendations on diet and physical activity, given basic nutrition booklet, plus usual prenatal care.	X	X	X	X	Fair
Cahill et al., 2018[86] PreGO	RCT N=240	One university hospital, St. Louis, Missouri	Overweight and obese	Counseling; High intensity	10 biweekly 1-hour visits	A. Intervention: PAT+Lifestyle curriculum, including biweekly home visits by a parent educator with individualized counseling on diet and exercise, behavior change, reinforcement of lifestyle behaviors in postpartum period to return to baseline weight, plus parenting strategies and social support postpartum. B. Comparison: PAT curriculum, including biweekly home visits by a parent educator with parenting strategies and social support.	X	X	X	X	Good
Haire-Joshu et al., 2019[103]	Same as Cahill et al., 2018 N=185	Same as Cahill et al., 2018	Same as Cahill et al., 2018	Same as Cahill et al., 2018	10 prenatal biweekly visits, 12 monthly postpartum visits (1 hour)	A. Same as Cahill et al., 2018; plus monthly visits from delivery to 12 months postpartum. B. Same as Cahill et al., 2018; plus monthly visits from delivery to 12 months postpartum.			X		Fair

Appendix E Table 1. Summary of Included Studies

Author, Year Study Name	Study Design N	Setting	Population BMI Category	Intervention Type; Intensity	Estimated Time	Description Intervention Comparison	Maternal Health Outcomes	Infant Health Outcomes	Weight Outcomes	Harms	Quality Rating
Claesson et al., 2010[87]	CCT N=348	Multiple antenatal care clinics, Sweden	Obese	Active; High intensity	Weekly 30-min in person; 1-2x per week exercise class (time NR), 3 follow-up visits (time NR)	A. Intervention: motivational interviewing during extra visits to midwife on weight control and counseling weekly; invitation to aqua aerobics class semiweekly. B. Comparison: usual prenatal care.			X	X	Fair
Daley et al., 2015[88]	RCT N=76	One community midwifery clinic, Birmingham, UK	Mixed	Counseling; Low intensity	NR - during visits	A. Intervention: personalized feedback at each visit on weight gain, self-weighing, brief counseling on diet and exercise as needed based on weight gain. B. Comparison: usual prenatal care.			X	X	Fair
Daley et al., 2019[89] POPS2	RCT N=616	Four maternity centers, England	Mixed	Counseling; Low intensity	NR – during visits	A. Intervention: personalized feedback at each visit on weight gain, self-weighing, brief counseling on diet and exercise as needed based on weight gain. B. Comparison: usual prenatal care.	X	X	X	X	Fair
Daly et al., 2017[90] Healthy eating, Exercise and Lifestyle Trial	RCT N=88	One university hospital, Dublin, Ireland	Obese	Active; High intensity	50-60 min 3x per week	A. Intervention: participation in medically supervised exercise classes during pregnancy and up to 6 weeks postpartum; personal goal setting; Facebook group. B. Comparison: usual prenatal care.	X	X	X	X	Fair

Appendix E Table 1. Summary of Included Studies

Author, Year Study Name	Study Design N	Setting	Population BMI Category	Intervention Type; Intensity	Estimated Time	Description Intervention Comparison	Maternal Health Outcomes	Infant Health Outcomes	Weight Outcomes	Harms	Quality Rating
Dodd et al., 2014[56] LIMIT	RCT N=2,212	Three maternity hospitals, Adelaide, Australia	Overweight and obese	Counseling; Moderate intensity	3 in-person visits; 3 phone calls (time NR)	A. Intervention: tailored dietary advice, recommendation for exercise, goal setting via in-person visits and phone calls. B. Comparison: usual prenatal care.	X	X	X	X	Good
Dodd et al., 2018[91]	Same as Dodd et al., 2014	Same as Dodd et al., 2014	Same as Dodd et al., 2014	Same as Dodd et al., 2014	Same as Dodd et al., 2014	Same as Dodd et al., 2014		X			Same as Dodd et al., 2014
Dodd et al., 2019[92] OPTIMISE	RCT N=633	One hospital Adelaide, Australia	Normal	Counseling; Moderate intensity	3 in-person visits; 3 phone calls (time NR)	A. Intervention: tailored dietary advice, recommendation for exercise, goal setting via in-person visits and phone calls. B. Comparison: usual prenatal care.	X	X	X	X	Good
Epel et al., 2019[93] MMT	Prospective cohort N=215	Hospital and community health centers San Francisco, CA	Overweight and obese	Counseling; High intensity	1 initial session, 8 group classes (2 hours 1x/wk), 2 phone calls (time NR), 1 postpartum group session	A. Intervention: Obesity-Related Behavioral Intervention Trials model, with sessions on mindful breathing, eating, and movement - nutritional and eating behavior, mindfulness-based eating awareness training, physical activity, and stress reduction. B. Comparison: treatment as usual group, comprised of women unable to attend group classes, or gestational age 20-23 weeks but otherwise would have been eligible for the intervention.				X	Good

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Author, Year Study Name	Study Design N	Setting	Population BMI Category	Intervention Type; Intensity	Estimated Time	Description Intervention Comparison	Maternal Health Outcomes	Infant Health Outcomes	Weight Outcomes	Harms	Quality Rating
Gallagher et al., 2018[94] LIFT	RCT N=210	Multiple hospital-affiliated clinics, U.S.	Overweight and obese	Counseling; High intensity	3 visits	A. Intervention: intensive counseling (individual and group) on behavior, nutrition, exercise; food and exercise logs; phone and email contact. B. Comparison: usual prenatal care, plus group education sessions on healthy lifestyle during pregnancy.	X	X	X	X	Fair
Garnaes et al., 2016[97] ETIP	RCT N=91	One university hospital, Trondheim, Norway	Overweight and obese	Active; High intensity	60 mins sessions 3x per week	A. Intervention: supervised aerobic and strength exercise classes from gestational week 12-18 until delivery, recommended exercise at home, individualized IOM weight gain curve. B. Comparison: usual prenatal care.	X	X	X		Fair
Garnaes et al., 2017[98]	Same as Garnaes et al., 2016	Same as Garnaes et al., 2016	Same as Garnaes et al., 2016	Same as Garnaes et al., 2016	Same as Garnaes et al., 2016	Same as Garnaes et al., 2016	X	X	X		Same as Garnaes et al., 2016
Garnaes et al., 2018[96]	Same as Garnaes et al., 2016	Same as Garnaes et al., 2016	Same as Garnaes et al., 2016	Same as Garnaes et al., 2016	Garnaes et al., 2016	Same as Garnaes et al., 2016			X		Good
Garnaes et al., 2019[95]	Same as Garnaes et al., 2016	Same as Garnaes et al., 2016	Same as Garnaes et al., 2016	Same as Garnaes et al., 2016	Same as Garnaes et al., 2016	Same as Garnaes et al., 2016				X	Fair

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Author, Year Study Name	Study Design N	Setting	Population BMI Category	Intervention Type; Intensity	Estimated Time	Description Intervention Comparison	Maternal Health Outcomes	Infant Health Outcomes	Weight Outcomes	Harms	Quality Rating
Gesell et al., 2015[99] Madre Sana, Bebé Sano / Healthy Mother, Healthy Baby	RCT N=135	Community center, Nashville, Tennessee	Mixed	Active; High intensity	12 weekly 90-min group sessions	A. Intervention: group intervention sessions (8-10 women plus facilitator) at community recreation center for healthy lifestyle intervention; also received infant injury prevention intervention. B. Comparison: home visits on infant injury prevention.			X		Fair
Gray-Donald, et al., 2000[100]	CCT N=219	Community-based prenatal clinics in Cree villages, Quebec	Mixed	Counseling; Moderate intensity	NR	A. Intervention: unclear; intervention based on social learning theory, administered by 2 nutritionists working with a team of health care workers, including a community nutritionist working in the Cree villages; frequency and type of contact not described. B. Comparison: no intervention.	X	X	X	X	Fair
Guelfi et al., 2016[101]	RCT N=172	Home-based supervised exercise Perth, Australia	Mixed	Active; High intensity	3 sessions per week (20-60 min) from weeks 14 to 28	A. Intervention: supervised home-based upright cycling, with progression to longer duration sessions depending on participant fitness. B. Comparison: usual prenatal care.	X	X	X	X	Fair
Haakstad et al., 2011[102]	RCT N=105	Community location, Oslo, Norway	Mixed	Active; High intensity	60 mins 2x week for 12 weeks	A. Intervention: supervised sessions of aerobic dance exercises for at least 12 weeks; weekly self-imposed physical activity. B. Comparison: usual prenatal care.		X	X		Fair

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Author, Year Study Name	Study Design N	Setting	Population BMI Category	Intervention Type; Intensity	Estimated Time	Description Intervention Comparison	Maternal Health Outcomes	Infant Health Outcomes	Weight Outcomes	Harms	Quality Rating
Harrison et al., 2013[104] HeLP-her	RCT N=228	Three teaching hospitals, Victoria, Australia	Overweight and obese	Counseling; Moderate intensity	4 sessions	A. Intervention: behavior change lifestyle intervention based on Social Cognitive Theory, including individualized dietary and PA advice, goal setting, self-monitoring. B. Comparison: educational control on general Australian dietary and PA guidelines.	X		X		Good
Harrison et al., 2014[105]	Same as Harrison et al., 2013	Same as Harrison et al., 2013	Same as Harrison et al., 2013	Same as Harrison et al., 2013	Same as Harrison, 2013	Same as Harrison et al., 2013			X		Same as Harrison et al., 2013
Hawkins et al., 2014[106] Estudio Vida	RCT N=68	Two medical centers, Massachusetts	Overweight and obese	Counseling; Moderate intensity	1 in-person session per month for 6 months, 5 phone booster sessions	A. Intervention: Six-month lifestyle intervention tailored to Hispanic women, based on the Transtheoretical model and Social Cognitive Theory; telephone booster sessions. B. Comparison: usual prenatal care.			X		Fair
Herring et al., 2016[108]	RCT N=66	Two hospital-affiliated obstetric clinics, Philadelphia, Pennsylvania	Overweight and obese	Counseling; High intensity	1 in-person session, 7 calls over 12 weeks	A. Intervention: eHealth intervention based on the Social Ecological Model delivered over 12 weeks. B. Comparison: usual prenatal care.	X	X	X	X	Fair
Herring et al., 2017[107]	Same as Herring et al., 2016	Same as Herring et al., 2016	Same as Herring et al., 2016	Same as Herring et al., 2016	Same as Herring et al., 2016	Same as Herring et al., 2016			X		Same as Herring et al., 2016

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Author, Year Study Name	Study Design N	Setting	Population BMI Category	Intervention Type; Intensity	Estimated Time	Description Intervention Comparison	Maternal Health Outcomes	Infant Health Outcomes	Weight Outcomes	Harms	Quality Rating
Hui et al., 2012[110]	RCT N=224	One prenatal clinic, Winnipeg, Manitoba	Mixed	Active; High intensity	30-45 mins per session 3-5x per week	A. Intervention: exercise regimen (walking, mild-to-moderate aerobic, stretching and strength exercises), in groups and at home. Dietary interviews and counselling were provided twice to each participant in the intervention group by registered dietitians. B. Comparison: usual prenatal care.	X	X	X		Fair
Hui et al., 2014[111]	RCT N=113	Community location, Winnipeg, Manitoba	Mixed	Active; High intensity	30-45 mins per session 3-5x per week	A. Intervention: community-based weekly exercise program, one-on-one private dietary consultation at baseline and 2 months later, used Food Choice Map software to assess dietary intake. B. Comparison: usual prenatal care.	X	X	X		Fair
Koivusalo et al., 2016[114] RADIEL	RCT N=293	Four maternity hospitals, Finland	Obese	Counseling; Moderate intensity	Three 2-hour sessions	A. Intervention: structured, individualized lifestyle counseling, dietary advice, and PA program, plus initial group visit with dietician and usual care. Counseling from study nurse. For prepregnancy BMI ≥30 kg/m^2, recommended no weight gain during first two trimesters. B. Comparison: usual prenatal care, information leaflets on healthy diet and exercise.	X	X	X		Fair
Huvinen et al., 2018[108]	Same as Koivusalo et al., 2016	Same as Koivusalo et al., 2016	Same as Koivusalo et al., 2016	Same as Koivusalo et al., 2016	Same as Koivusalo et al., 2016	Same as Koivusalo et al., 2016			X		Same as Koivusalo et al., 2016

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Author, Year Study Name	Study Design N	Setting	Population BMI Category	Intervention Type; Intensity	Estimated Time	Description Intervention Comparison	Maternal Health Outcomes	Infant Health Outcomes	Weight Outcomes	Harms	Quality Rating
Rono et al., 2018a[137]	Same as Koivusalo et al., 2016 N=128	Same as Koivusalo et al., 2016	Same as Koivusalo et al., 2016	Same as Koivusalo et al., 2016	1x every 3 months before pregnancy (time NR), three 2-hour sessions	Same as Koivusalo et al., 2016. *Specific to Rono 2018a: prepregnancy recommendation for 5-10% weight loss prior to pregnancy for women BMI ≥25 kg/m^2.	X	X	X		Fair
Rono et al., 2018b[136]	Same as Koivusalo et al., 2016 N=492	Same as Koivusalo et al., 2016	Same as Koivusalo et al., 2016	Same as Koivusalo et al., 2016	2 hour x3 sessions	Same as Koivusalo et al., 2016	X	X	X		Fair
Kunath et al., 2019[115] GeliS	Cluster RCT N=2,261	Gynecologic and midwifery practices Bavaria, Germany	Mixed	Counseling; Moderate intensity	4 sessions (30-45 min each; 3 prenatal, 1 postpartum)	A. Intervention: individual prenatal and postpartum in-person counseling sessions; counseling on self-monitoring weight gains based on IOM recommendations, healthy nutrition and balanced diet based on Healthy Start guidelines, recommended physical activity. B. Comparison: usual prenatal care, general information leaflets on healthy lifestyle in pregnancy.	X	X	X	X	Fair
Hoffman et al., 2019[109]	Same as Kunath et al., 2019 N=1,998	Same as Kunath et al., 2019	Same as Kunath et al., 2019	Same as Kunath et al., 2019	Same as Kunath et al., 2019	Same as Kunath et al., 2019			X		Same as Kunath et al., 2019

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Author, Year Study Name	Study Design N	Setting	Population BMI Category	Intervention Type; Intensity	Estimated Time	Description Intervention Comparison	Maternal Health Outcomes	Infant Health Outcomes	Weight Outcomes	Harms	Quality Rating
LeBlanc et al., 2020[116] PREPARE	RCT N=326	Telephone and online, Oregon and Washington	Overweight and Obese	Counseling; High	30-40 min initial session, 20-30 min session weekly (6 months) and monthly (up to 18 months or until pregnancy end)	A. Intervention: prepregnancy counseling focused on losing weight (dietary [DASH] and physical activity counseling); during pregnancy counseling focused on adhering to GWG guidelines, logging weight, food, and exercise into study website. B. Comparison: usual prenatal care, information on having a healthy pregnancy.			X		Good
Luoto et al., 2011[117] NELLI	RCT N=442	Primary health care center-affiliated maternity clinics, 14 municipalities, Finland	Mixed	Counseling; Moderate intensity	One 2-hour PA session; one dietary counseling session; 3-4 booster sessions	A. Intervention: physical activity counseling session, diet counseling session, physical activity boosters and diet boosters during visits, invitations to group meetings. B. Comparison: usual prenatal care.	X	X	X	X	Good
Kinnunen et al., 2012[113]	Same as Luoto et al., 2011	Same as Luoto et al., 2011	Same as Luoto et al., 2011	Same as Luoto et al., 2011	Same as Luoto et al., 2011	Same as Luoto et al., 2011			X		Same as Luoto et al., 2011
Magriples et al., 2015[118] Centering Pregnancy Plus	RCT N=984	14 community health centers and hospitals, New York City, New York	Mixed	Counseling; Moderate intensity	10 sessions (120 mins each)	A. Intervention: group prenatal care, standard clinical intake, then groups of 8-12 women at same gestational age facilitated by 2 health providers, manualized curriculum. B. Comparison: usual prenatal care.			X		Fair

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Author, Year Study Name	Study Design N	Setting	Population BMI Category	Intervention Type; Intensity	Estimated Time	Description Intervention Comparison	Maternal Health Outcomes	Infant Health Outcomes	Weight Outcomes	Harms	Quality Rating
McCarthy et al., 2016[119] FFF	RCT N=382	One tertiary obstetric hospital, Melbourne, Australia	Overweight and obese	Counseling; Low intensity	30 mins x1 session	A. Intervention: Serial self-weighing and simple dietary advice. B. Comparison: usual prenatal care	X	X	X	X	Fair
McGiveron et al., 2015[120] Bumps and Beyond	CCT N=178	One antenatal clinic, Lincolnshire, UK	Obese	Counseling; Moderate intensity	8 sessions	A. Intervention: Bumps and Beyond intervention, including an educational booklet and one-on-one counseling sessions regarding diet, exercise, and healthy weight gain in pregnancy delivered approximately from 16 weeks until 6 weeks postpartum. B. Comparison: declined intervention.	X	X	X		Fair
Okesene-Gafa et al., 2019[121] HUMBA	RCT N=230	University, home-based visits South Auckland, Australia	Obese	Counseling; High intensity	4 sessions (1 at 1.5 hr, 3 at 30-60 min); text messages 3x per week	A. Intervention: individual, home-based education sessions including feedback on weight gain and SMARTER goals, HUMBA handbook with nutrition information, recipes, management of cravings, physical activity tips, motivational text messages worded as if from the baby regarding nutrition, plus probiotic or placebo capsules B. Comparison: usual prenatal care, NZ pamphlet on healthy eating and weight gain during pregnancy, plus probiotic or placebo capsules	X	X	X	X	Good

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Author, Year Study Name	Study Design N	Setting	Population BMI Category	Intervention Type; Intensity	Estimated Time	Description Intervention Comparison	Maternal Health Outcomes	Infant Health Outcomes	Weight Outcomes	Harms	Quality Rating
Olson et al., 2018[122] e-Moms	RCT N=1,689	Online, Rochester, New York	Mixed	Counseling; Moderate intensity	NR	A. Intervention: intervention website, including weight gain tracker, a diet and exercise goal-setting tool, and health information, accessed through 6 weeks postpartum. B. Intervention: intervention website, weight gain tracker, a diet and exercise goal-setting tool, and health information, accessed until delivery only. C. Comparison: control website, including only health information.	X	X	X	X	Fair
Peccei et al., 2017[123]	RCT N=272	One hospital-affiliated prenatal clinic, Revere, Massachusetts	Overweight and obese	Counseling; Moderate intensity	60-90 mins initial session, 10-30 mins 2x per month	A. Intervention: culturally appropriate, individualized meal plans and counseling on nutrition, exercise, reading food labels, shopping for food on a budget, and breastfeeding; weight tracking. B. Comparison: standard counseling on diet and exercise at randomization, and again at 6 weeks postpartum.	X	X	X	X	Fair
Pelaez et al., 2019[124]	RCT N=301	One university hospital, Madrid, Spain	Mixed	Active; High intensity	70-78 sessions (60-65 min 3x per week)	A. Intervention: structured, supervised exercise from weeks 12 to 36; 60-65 min sessions 3x per week (planned 70-78 sessions). B. Comparison: usual prenatal care.	X	X	X		Fair
Perales et al., 2015[125]	RCT N=129	One university hospital, Madrid	Overweight and obese	Active; High intensity	85 sessions (55-60 min)	A. Intervention: exercise sessions planned for a total of 85 sessions. B. Comparison: usual prenatal care.	X		X	X	Good

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Author, Year Study Name	Study Design N	Setting	Population BMI Category	Intervention Type; Intensity	Estimated Time	Description Intervention Comparison	Maternal Health Outcomes	Infant Health Outcomes	Weight Outcomes	Harms	Quality Rating
Petrella et al., 2014[126]	RCT N=63	One hospital-based obstetrics unit, Modena, Italy	Overweight and obese	Counseling; Low intensity	4 sessions (initial session 60 min; remainder time NR)	A. Intervention: Therapeutic Lifestyle Changes diet and exercise intervention, follow-up sessions to track adherence to program. B. Comparison: nutritional booklet, usual prenatal care.	X	X	X		Fair
Phelan et al., 2011[128] Fit For Delivery	RCT N=401	Six obstetrics offices, Providence, Rhode Island	Mixed	Counseling; Moderate intensity	One in-person session, three 10-15 min phone calls	A. Intervention: in-person meeting plus phone calls following the Fit for Delivery behavioral intervention targeting diet and physical activity; women who were over or under guidelines received additional calls. B. Comparison: in-person meeting, usual prenatal care, study newsletters.	X	X	X	X	Fair
Phelan et al., 2014[127]	Same as Phelan et al., 2011	Same as Phelan et al., 2011	Same as Phelan et al., 2011	Same as Phelan et al., 2011	Same as Phelan et al., 2011	Same as Phelan et al., 2011			X		Same as Phelan et al., 2011
Phelan et al., 2018[130] Healthy Beginnings / Comienzo Saludables	RCT N=264	Two hospitals, San Luis Obispo, California and Providence, Rhode Island	Overweight and obese	Active; High intensity	Biweekly session (20 min) until 20 weeks' gestation, monthly session until delivery	A. Intervention: biweekly in-person sessions until 20 weeks' gestation, then monthly until delivery, on appropriate weight gain, physical activity, behavioral strategies for daily self-monitoring; partial meal replacement plan; goal setting for postnatal period. B. Comparison: usual prenatal care, plus initial welcome visit, study newsletters.	X	X	X	X	Fair

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Author, Year Study Name	Study Design N	Setting	Population BMI Category	Intervention Type; Intensity	Estimated Time	Description Intervention Comparison	Maternal Health Outcomes	Infant Health Outcomes	Weight Outcomes	Harms	Quality Rating
Phelan et al., 2019[129]	Same as Phelan et al., 2018	Same as Phelan et al., 2018	Same as Phelan et al., 2018	Same as Phelan et al., 2018	Same as Phelan et al., 2018	Same as Phelan et al., 2018			X		Fair
Polley et al., 2002[131]	RCT N=120	One obstetric clinic, Pittsburgh, Pennsylvania	Mixed	Counseling; Low intensity	NR	A. Intervention: written information on targeting appropriate weight gain in pregnancy, exercise, and diet; newsletters; personalized graph of weight gain; stepped care for with more structure for goals if weight exceeded recommendations; check-in phone calls. B. Comparison: usual prenatal care.	X	X	X	X	Fair
Rauh et al., 2013[132] FeLIPO	RCT N=250	Eight gynecology practices, Munich, Germany	Mixed	Counseling; Low intensity	Two sessions (initial 60 min, second 30 min)	A. Intervention: individual counseling module intervention targeting healthy lifestyle information, self-monitoring of diet and physical activity, self-monitoring of weight gain, and setting personal behavioral goals. B. Comparison: usual prenatal care.	X	X	X	X	Fair
Rauh et al., 2015[133]	Same as Rauh et al., 2013	Same as Rauh et al., 2013	Same as Rauh et al., 2013	Same as Rauh et al., 2013	Same as Rauh et al., 2013	Same as Rauh et al., 2013		X	X		Same as Rauh et al., 2013

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Author, Year Study Name	Study Design N	Setting	Population BMI Category	Intervention Type; Intensity	Estimated Time	Description Intervention Comparison	Maternal Health Outcomes	Infant Health Outcomes	Weight Outcomes	Harms	Quality Rating
Redman et al., 2017[134] SmartMoms	RCT N=54	Social media or community clinics, U.S.	Overweight and obese	Counseling; High intensity	18 lessons	A. Intervention: in-person SmartMoms intervention, received dietary intake advice, exercise advice, weight graph for trimester-specific increase in energy intake for adherence to IOM recommendation. Structured intervention consisted of lessons and behavior modification counseling weekly (13-24 weeks), then biweekly (week 25 to delivery). B. Intervention: remote SmartMoms Intervention, same as above intervention, but delivered via intensity-matched phone app. C. Comparison: usual prenatal care.			X		Fair
Renault et al., 2014[58] TOP	RCT N=425	Hospital-based clinic, Copenhagen, Denmark	Obese	Counseling; High intensity	11-13 biweekly sessions	A. Intervention: PA plus D (physical activity and dietary intervention), with followup on dietary advice and encouragement to increase physical activity as assessed by pedometer. B. Intervention: PA (physical activity) only, encouraged to increase physical activity as assessed by pedometer. C. Comparison: usual prenatal care.	X	X	X	X	Good

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Author, Year Study Name	Study Design N	Setting	Population BMI Category	Intervention Type; Intensity	Estimated Time	Description Intervention Comparison	Maternal Health Outcomes	Infant Health Outcomes	Weight Outcomes	Harms	Quality Rating
Ronnberg et al., 2014[135]	RCT N=445	14 antenatal clinics, Örebro County, Sweden	Mixed	Counseling; Low intensity	1 session	A. Intervention: individual education on IOM guidelines for recommended GWG by BMI category, personalized graph to monitor with midwife, weight discussed at each visit, formalized prescription of PA (recommended daily moderate PA). B. Comparison: usual prenatal care.			X		Fair
Ruiz et al., 2013[138]	RCT N=962	Three primary care medical centers, Madrid, Spain	Mixed	Active; High intensity	50-55 min exercise session 3x per week (planned 85 sessions)	A. Intervention: structured, supervised, light-to-moderate intensity exercise intervention program from week 9 to weeks 38/39. A mean of 85 training sessions were planned for each participant in the event of no preterm delivery. B. Comparison: usual prenatal care.	X	X	X	X	Fair
Sagedal et al., 2017[139] Norwegian Fit For Delivery	RCT N=606	Eight healthcare clinics, Norway	Mixed	Active; High intensity	Two 20-min dietary counseling sessions, 60 mins recommended exercise sessions 2x per week	A. Intervention: dietary counseling sessions on awareness of food choices, access to exercise classes, lifestyle recommendations from booklets and trial website, cooking class. B. Comparison: usual prenatal care.	X	X	X	X	Good
Sagedal et al., 2017b[140]	Same as Sagedal et al., 2017	Same as Sagedal et al., 2017	Same as Sagedal et al., 2017	Same as Sagedal et al., 2017	Same as Sagedal et al., 2017	Same as Sagedal et al., 2017			X		Same as Sagedal et al., 2017

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Author, Year Study Name	Study Design N	Setting	Population BMI Category	Intervention Type; Intensity	Estimated Time	Description Intervention Comparison	Maternal Health Outcomes	Infant Health Outcomes	Weight Outcomes	Harms	Quality Rating
Seneviratne et al., 2016[136]	RCT N=75	Home-based supervised exercise Auckland, New Zealand	Overweight and obese	Active; High intensity	15-30 min exercise 3-5x per week (planned 67 sessions, from 20-35 weeks' gestation)	A. Intervention: written program prescribing frequency and duration of weekly moderate-intensity exercise using magnetic stationary bicycle. B. Comparison: usual prenatal care.	X	X	X	X	Good
Simmons et al., 2017[142] DALI Lifestyle	RCT N=436	Antenatal clinics across 11 centers in nine European countries (Austria, Belgium, Denmark, Ireland, Italy, Netherlands, Poland, Spain, UK)	Obese	Counseling; Moderate intensity	5 in-person sessions (30-45 min); ≤4 telephone calls (≤20 min) or emails	A. Intervention A: assigned healthy eating (HE) lifestyle coach, individual sessions on 7 messages promoting healthy eating, study toolkit. B. Intervention B: assigned physical activity (PA) lifestyle coach, 5 messages promoting aerobic and resistance PA, study toolkit. C. Intervention C: HE and PA interventions combined. D. Comparison: usual prenatal care.	X	X	X	X	Good
Skouteris et al., 2016[143] HIPP	RCT N=261	Two antenatal clinics, Melbourne, Australia	Mixed	Counseling; Moderate intensity	Initial in-person session (60 min at 18 weeks), followup session (30 min at 24 weeks), 2 phone calls (15 min)	A. Intervention: individual health coaching intervention, telephone followup sessions, and educational group sessions. B. Comparison: education group session for control.	X	X	X	X	Fair

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Author, Year Study Name	Study Design N	Setting	Population BMI Category	Intervention Type; Intensity	Estimated Time	Description Intervention Comparison	Maternal Health Outcomes	Infant Health Outcomes	Weight Outcomes	Harms	Quality Rating
Smith et al., 2016[144]	RCT N=51	Online, U.S.	Mixed	Counseling; Moderate intensity	1 in-person training session	A. Intervention: web-based behavioral intervention including exercise goal-setting modules, problem-solving modules, journal, calendar to track all exercise until delivery, community forum to interact with other participants in the intervention. B. Comparison: usual prenatal care, plus access to the website's general pages with information on recommended PA and weight gain during pregnancy.			X		Fair
Thomson et al., 2016[148] Delta Healthy Sprouts	RCT N=105	Homes, Lower Delta region, Mississippi	Mixed	Counseling; High intensity	Monthly home visits (intervention 90-120 min; control 60-90 min)	A. Intervention (PATE): home visits using PAT curriculum plus culturally tailored maternal weight management and early childhood obesity prevention components. Based on DPP and inFANT trial, with emphasis placed on healthy eating and weight control during pregnancy. B. Comparison (PAT): home visits using PAT curriculum, monthly group meetings, developmental screenings, and a resource network for families.	X	X	X	X	Fair
Thomson et al., 2018[147]	Same as Thomson et al., 2016 N=54	Same as Thomson et al., 2016	Same as Thomson et al., 2016	Same as Thomson et al., 2016	18 monthly visits (gestational month 4 - postpartum month 12; 90-120 min)	Same as Thomson et al., 2016		X			Fair

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Author, Year Study Name	Study Design N	Setting	Population BMI Category	Intervention Type; Intensity	Estimated Time	Description Intervention Comparison	Maternal Health Outcomes	Infant Health Outcomes	Weight Outcomes	Harms	Quality Rating
Van Horn et al., 2018[149] MOMFIT	RCT N=281	University hospital Chicago, Illinois	Overweight and obese	Counseling; High intensity	3 individual visits (time NR), 9 telephone calls (time NR), six 30-min group sessions	A. Intervention: education on MAMA-DASH diet (modified DASH diet for pregnancy), food intake tracking, PA guidelines, individual emails, text messages, and phone calls using motivational interviewing from registered dietician nurse, emails with educational materials and resources, MOMFIT website, group sessions on lifestyle and breastfeeding. B. Comparison: usual prenatal care, access to MOMFIT website with general dietary and pregnancy care information.	X	X	X	X	Fair
Vesco et al., 2014[150] Healthy Moms	RCT N=118	One managed care organization, Oregon and Washington	Obese	Counseling; High intensity	2 individual sessions (time NR), 16 group sessions (90 min)	A. Intervention: individual counseling session, group sessions, diet and exercise intervention, with diet based on DASH and recommended daily moderate PA. B. Comparison: usual prenatal care, with a single general health education session as control.	X	X	X	X	Good
Vesco et al., 2016[151]	Same as Vesco et al., 2014	Same as Vesco et al., 2014	Same as Vesco et al., 2014	Same as Vesco et al., 2014	Same as Vesco et al., 2014	Same as Vesco et al., 2014		X	X		Same as Vesco et al., 2014

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Author, Year Study Name	Study Design N	Setting	Population BMI Category	Intervention Type; Intensity	Estimated Time	Description Intervention Comparison	Maternal Health Outcomes	Infant Health Outcomes	Weight Outcomes	Harms	Quality Rating
Vinter et al., 2011[59] LiP	RCT N=360	Two university hospitals, Denmark	Obese	Active; High intensity	4 sessions	A. Intervention: dietary counseling at 15, 20, 28, and 35 weeks' gestation, recommended daily moderate PA, pedometer, free full-time membership in a fitness center for 6 months, closed individual and group training classes with physiotherapists. B. Comparison: access to a website with general advice about dietary habits and PA in pregnancy.	X	X	X	X	Fair
Vinter et al., 2014[152]	Same as Vinter et al., 2011	Same as Vinter et al., 2011	Same as Vinter et al., 2011	Same as Vinter et al., 2011	Same as Vinter et al., 2011	Same as Vinter et al., 2011			X		Same as Vinter et al., 2011
Tanvig et al., 2014[146]	Same as Vinter et al., 2011	Same as Vinter et al., 2011	Offspring of women with obesity	Same as Vinter et al., 2011	Same as Vinter et al., 2011	Same as Vinter et al., 2011		X			Same as Vinter et al., 2011
Tanvig et al., 2015[145]	Same as Vinter et al., 2011	Same as Vinter et al., 2011	Offspring of women with obesity	Same as Vinter et al., 2011	Same as Vinter et al., 2011	Same as Vinter et al., 2011		X			Same as Vinter et al., 2011
Willcox et al., 2017[153] txt4two	RCT N=100	Mobile devices, Melbourne, Australia	Overweight and obese	Counseling; High intensity	15 min introduction meeting	A. Intervention: multimodal, including face-to-face introduction, text messages, website, video messages, chat room interaction, all informed by Social Cognitive Theory and CALO-RE taxonomy of behavior changes, emphasize daily moderate PA. B. Comparison: usual prenatal care.			X		Fair

Appendix E Table 1. Summary of Included Studies

Author, Year Study Name	Study Design N	Setting	Population BMI Category	Intervention Type; Intensity	Estimated Time	Description Intervention Comparison	Maternal Health Outcomes	Infant Health Outcomes	Weight Outcomes	Harms	Quality Rating
Wolff et al., 2008[154]	RCT N=50	Two hospitals, Denmark	Obese	Counseling; Moderate intensity	Ten 60-min sessions	A. Intervention: in-person visits with nutritionist on eating a healthy diet; given energy restricted diet plan. B. Comparison: usual prenatal care.	X		X		Fair

Note: Low intensity = 0-2 contacts during intervention; Moderate intensity = 3-11 contacts during intervention; High intensity = 12 or more contacts during intervention.

Abbreviations: ACOG = American College of Obstetricians and Gynecologists; BMI = body mass index; CALO-RE = Coventry, Aberdeen, and London-Refined; CCT = controlled clinical trial; DASH = Dietary Approaches to Stopping Hypertension; DPP = Diabetes Prevention Program; ESTEEM = Effect of Simple, Targeted Diet in Pregnant Women with Metabolic Risk Factors on Pregnancy Outcomes; ETIP = Exercise Training in Pregnancy; GWG = gestational weight gain; HE = healthy eating; HUMBA = Healthy Mums and Babies; inFANT = infant Feeding Activity and Nutrition Trial; IOM = Institute of Medicine; LIFT= Lifestyle Interventions For Two; MMT = Mindful MAMAS Training; MOMFIT = Maternal Offspring Metabolics Family Intervention Trial; NR = not reported; PA = physical activity; PAT = Parents As Teachers; RCT = randomized clinical trial; SWEP = Study Water Exercise Pregnant; TOP = Treatment of Obese Pregnant Women.

Appendix E Table 2. Behavioral and Counseling Intervention Implementation Table: Summary and Examples of Included Interventions for Healthy Weight and Weight Gain During Pregnancy

Primary Population	Pregnant women with normal, overweight, or obese BMI.			
Primary outcomes	Pregnancy weight-related intermediate outcomes; maternal health outcomes including maternal mortality, maternal morbidity, and health outcomes; infant outcomes, including infant mortality, infant, and infant health outcomes.			
Study Findings	Counseling and active behavioral interventions to limit GWG in pregnant women are associated with modest reductions in weight gain and decreased likelihood of exceeding IOM recommendations for GWG. Effects of these interventions on mean GWG are slightly more pronounced for high intensity interventions. GWG interventions are also associated with a modestly decreased risk of GDM, macrosomia, large for gestational age, and reduced postpartum weight retention at 12 months			
Behavior change goals and techniques	A variety of therapeutic approaches to help participants limit excess GWG through counseling, active interventions, or a combination. Counseling included education regarding healthy diet and/or physical activity during pregnancy in person, online, or via telephone. Active interventions included structured medically-supervised exercise classes or partial meal replacement. Behavior change techniques included goal setting, active use of self-monitoring, and addressing barriers related to healthy lifestyle adoption and maintenance.			
Intervention duration and Intensity	The majority of interventions began at the end of the first trimester or beginning of second trimester, and concluded prior to or at delivery. Intensity was defined as high (12 or more contacts beyond usual care during the intervention period), moderate (3-11 contacts), or low (fewer than 2 contacts).			
Settings of studies	Primary care or primary care-referable settings, and routine prenatal care settings including obstetric and gynecology or midwifery clinics, and hospitals.			
To whom is intervention targeted?	Most of the effective interventions were targeted to women with obesity or combined obesity or overweight prepregnancy BMI. Much of the available evidence is for interventions beginning after the first trimester and ending in the third trimester. Evidence for women of advanced maternal age or adolescence and those planning pregnancy was limited, as was evidence for effects of interventions reported out by women identifying as socioeconomic, racial or ethnic minority, or other populations experiencing health disparities.			
	Effective interventions defined by type and intensity of intervention			
EXAMPLE INTERVENTIONS TO LIMIT EXCESS GWG*†	**Active / Supervised Exercise**	**Counseling**		
	High Intensity k=22	**High Intensity k=13**	**Moderate Intensity k=23**	**Low Intensity k=10**
Mode and intensity of delivery*†	Structured, supervised exercise classes one to three time per week (average 45-60 minutes). Classes included aerobic, resistance, and flexibility exercises based on American College of Obstetricians and Gynecology recommendations for exercise during pregnancy. Intervention participants generally used free weights and/or resistance equipment.	Individual or group counseling in person, online, or over the phone. Sessions ranged from once a week to once a month, lasting from 30 minutes to 2 hours. Counseling focused on nutrition, goal-setting, physical activity, behavioral and social support strategies. Few interventions followed evidence-based, structured curricula. Interventions may have included phone call or email followups one to two times per week; eHealth interventions offered online or text message support.	Individual or group counseling in person or over the phone. Sessions ranged from once a month to once a trimester, lasting from 15 to 45 minutes. Counseling focused on recommendations for healthy eating and/or or physical activity based on ACOG guidelines. Interventions may have included phone call 'booster' sessions and toolkits with educational materials or physical activity accessories for participants.	Individual sessions as part of usual antenatal care, or one to two brief extra sessions. Counseling focused on maintaining healthy weight, and often included personalized graphs with weight gain guidance based on IOM recommendations.

Appendix E Table 2. Behavioral and Counseling Intervention Implementation Table: Summary and Examples of Included Interventions for Healthy Weight and Weight Gain During Pregnancy

Example interventions*†	Bacchi 2018 Barakat 2014 Barakat 2016 Barakat 2018 Barakat 2019 Pelaez 2019 Phelan 2018 (Healthy Beginnings) Ruiz 2013 Sagedal 2017 (Norwegian Fit for Delivery) Seneviratne 2016 Vinter 2011 (LiP)	Altazan 2019 (Expecting Success / SmartMoms) Cahill 2018 (PreGO) Gallagher 2018 (LIFT) Renault 2014 (TOP) Van Horn 2018 (MOMFIT) Vesco 2014 (Healthy Moms) Willcox 2017 (txt4two)	Al Wattar 2019 (ESTEEM) Bogaerts 2013 Bruno 2017 Phelan 2011 (Fit for Delivery)	Assaf-Balut 2017 Rauh 2013 (FeLIPO) Ronnberg 2014
Materials and practice§	https://lifemoms.bsc.gwu.edu/ https://www.acog.org/-/media/Committee-Opinions/Committee-on-Obstetric-Practice/co650.pdf?dmc=1&ts=20191118T2204318485	https://www.nhlbi.nih.gov/health-topics/dash-eating-plan https://www.webcitation.org/6QR3k6uaM https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6352352/bin/12884_2019_2196_MOESM1_ESM.docx	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6650045/bin/pmed.1002857.s005.docx https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6650045/bin/pmed.1002857.s006.docx https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6650045/bin/pmed.1002857.s007.docx	https://oldwayspt.org/traditional-diets/mediterranean-diet http://resources.nationalacademies.org/Pregnancy/WhatToGain.html
Evidence of effect modification	Evidence that providing these specific counseling or active interventions was more effective than usual care in limiting excess gestational weight gain, particularly among women with overweight or obesity; and in reducing rates of gestational diabetes mellitus and risk of emergency cesarean delivery. Evidence of association between mean gestational weight gain and intervention intensity. No association with BMI group, weight assessment timepoint, type of intervention, or study quality. Evidence of association with BMI subgroup perineal trauma; intervention intensity and gestational hypertension, perineal trauma, macrosomia, exceeding GWG recommendations, and SGA; and intervention type and gestational hypertension and exceeding GWG recommendations. Evidence of association with weight assessment at 12 months postpartum and postpartum weight retention.			
Comparison group	Minimal weight loss intervention or usual care consisting of generic print or web-based materials focused on healthy lifestyle during pregnancy, diet and physical activity changes, or limiting excess gestational weight gain.			
Interventionist and training required	Midwives, health educators, physical therapists, fitness specialists, or clinical and registered dieticians. Interventionists had professional certification in their respective fields, education regarding study goals and processes, and/or training on standard study curricula.			
Reported intervention adherence	9.7% to 100% of intervention participants completed the full intervention in studies reporting adherence.			

Note: Low intensity = 0-2 contacts during intervention; Moderate intensity = 3-11 contacts during intervention; High intensity = 12 or more contacts during intervention.
* Examples selected from good- or fair-quality‡ RCTs with low risk of bias, statistically significant effect on outcomes in meta-analysis (mean or excess GWG, reducing rates of GDM), n>100, transparent access to intervention details (e.g., public website or protocol paper). See Appendix B for intervention details and practice materials (where applicable).
† Included of studies is for example purposes only and does not indicate endorsement by the USPSTF.
‡ As assessed using criteria developed by the USPSTF to rate the quality of each study as good, fair, or poor.
§ Materials and Practice sources were identified by examining published studies and public resources.