Evidence Portfolio – Pregnancy and Postpartum Work Group, Question 2

What is the relationship between physical activity and the incidence of gestational diabetes mellitus?

a. What dose of physical activity is associated with the reported quantitative benefit or risk?
b. Is there a dose-response relationship? If yes, what is the shape of the relationship?
c. Does the relationship vary by age, ethnicity, socio-economic status, or weight status?

Sources of Evidence: Existing Systematic Review and Meta-Analyses

Conclusion Statements and Grades

Strong evidence demonstrates a significant inverse relationship between physical activity and risk of gestational diabetes mellitus. **PAGAC Grade: Strong**

Limited evidence suggests that a dose of physical activity similar to the 2015 ACOG Guidelines and the 2008 Physical Activity Guidelines is associated with a lower risk of gestational diabetes mellitus. **PAGAC Grade: Limited.**

Limited evidence suggests that a dose-response relationship exists between physical activity and gestational diabetes mellitus. **PAGAC Grade: Limited**.

Insufficient evidence is available to determine whether the relationship between physical activity and gestational diabetes mellitus varies by age, race/ethnicity, socioeconomic status, or weight status. **PAGAC Grade: Not assignable**.

Description of the Evidence

To address its research questions, the Pregnancy and Postpartum Work Group conducted one search for systematic reviews, meta-analyses, pooled analyses, and reports on preeclampsia and eclampsia and chose to rely on 7 searches conducted by PAGAC subcommittees that were considered to have the potential to provide pertinent information on pregnancy and postpartum. The 7 searches conducted by subcommittees included:

1. Cardiometabolic Health and Weight Management Q1: What is the relationship between physical activity and prevention of weight gain?
2. Cardiometabolic Health and Weight Management Q2: In people with normal blood pressure or pre-hypertension, what is the relationship between physical activity and blood pressure?
3. Cardiometabolic Health and Weight Management Q3: In adults without diabetes, what is the relationship between physical activity and type 2 diabetes?
4. Brain Health Q2: What is the relationship between physical activity and quality of life?

5. Brain Health Q3: What is the relationship between physical activity and (1) affect, (2) anxiety, and (3) depressed mood and depression?
6. Brain Health Q4: What is the relationship between physical activity and sleep?
7. Aging Q2: What is the relationship between physical activity and physical function?

Additional searches for systematic reviews, meta-analyses, pooled analyses, reports, or original research were not conducted based on the a priori decision to focus on existing reviews.

Existing Systematic Review and Meta-Analyses

Overview

A total of 15 existing reviews that examined the association between physical activity and the incidence of gestational diabetes mellitus were included: 14 meta-analyses[1-14] and 1 systematic review.[15] The reviews were published from 2008 to 2017.

The meta-analyses included a range of 5 to 81 studies and covered the following timeframe: from inception to 2015[1, 2, 10]; inception to 2016[3, 14]; inception to 2012[5]; 1966 to 2012[6]; 1980 to 2011[7]; inception to 2014[8]; 1990 to 2014[9]; inception to 2010[11]; 1966 to 2013[12]; and inception to 2017.[13] The meta-analysis by DiNallo and Downs[4] did not report a specific timeframe.

The systematic review[15] included 41 studies, of which 7 assessed physical activity as an exposure. The review covered a timeframe from 1992 to 2006.

Exposures

The included reviews examined different types of physical activity performed before and during pregnancy. Most reviews assessed structured exercise interventions using different modalities, including aerobic and strength training. Some specific types of physical activity assessed included total and/or leisure-time physical activity,[1, 2] aerobic exercise,[3] or total physical activity, walking, stair climbing, vigorous activity, and physical inactivity.[11]

Outcomes

All the reviews examined risk or incidence of gestational diabetes mellitus.

Populations Analyzed

The table below lists the populations analyzed in each article.

Table 1. Populations Analyzed by All Sources of Evidence

	Sex	Race/ Ethnicity	Age	Weight Status	Pregnancy
Aune, 2016		Female			Pregnant
da Silva, 2017	Female				Pregnant
Di Mascio, 2016		Female		Normal/Healthy Weight (BMI: 18.5–24.9)	Pregnant
DiNallo, 2008		Female	Adults 19–48		Pregnant
Dode, 2009		Female			Pregnant
Han, 2012	Female		Adults		Pregnant
Madhuvrata, 2015		Female	Mean age 30.4		Pregnant
Oostdam, 2011		Female			Pregnant
Russo, 2015		Female			Pregnant
Sanabria-Martinez, 2015	Female				Pregnant
Song, 2016		Female	Adults <30, ≥30	Normal/Healthy Weight (BMI: 18.5–24.9), Overweight and Obese	Pregnant
Tobias, 2011		Female			Pregnant
Yin, 2014		Female			Pregnant
Yu, 2017		Female			Pregnant
Zheng, 2017		Female			Pregnant

Supporting Evidence

Existing Systematic Review and Meta-Analyses

Table 2. Existing Systematic Review and Meta-Analyses Individual Evidence Summary Tables

<table>
<tr><td colspan="2">Meta-Analysis
Citation: Aune D, Sen A, Henriksen T, Saugstad OD, Tonstad S. Physical activity and the risk of gestational diabetes mellitus: a systematic review and dose-response meta-analysis of epidemiological studies. Eur J Epidemiol. 2016;31(10):967–997. doi:10.1007/s10654-016-0176-0.</td></tr>
<tr><td>Purpose: To clarify whether there is a dose–response relationship between increasing PA level and lower risk of gestational diabetes mellitus.</td><td rowspan="4">Abstract: Physical activity has been inconsistently associated with risk of gestational diabetes mellitus in epidemiological studies, and questions remain about the strength and shape of the dose-response relationship between the two. We therefore conducted a systematic review and meta-analysis of cohort studies and randomized trials on physical activity and gestational diabetes mellitus. PubMed, Embase and Ovid databases were searched for cohort studies, and randomized controlled trials of physical activity and risk of gestational diabetes mellitus, up to August 5th 2015. Summary relative risks (RRs) were estimated using a random effects model. Twenty-five studies (26 publications) were included. For total physical activity the summary RR for high versus low activity was 0.62 (95 % CI 0.41-0.94, I2 = 0 %, n = 4) before pregnancy, and 0.66 (95 % CI 0.36-1.21, I2 = 0 %, n = 3) during pregnancy. For leisure-time physical activity the respective summary RRs for high versus low activity was 0.78 (95 % CI 0.61-1.00, I2 = 47 %, n = 8) before pregnancy, and it was 0.80 (95 % CI 0.64-1.00, I2 = 17 %, n = 17) during pregnancy. The summary RR for pre-pregnancy activity was 0.70 (95 % CI 0.49-1.01, I2 = 72.6 %, n = 3) per increment of 5 h/week and for activity during pregnancy was 0.98 (95 % CI 0.87-1.09, I2 = 0 %, n = 3) per 5 h/week. There was evidence of a nonlinear association between physical activity before pregnancy and the risk of gestational diabetes mellitus, pnonlinearity = 0.005, with a slightly steeper association at lower levels of activity although further reductions in risk were observed up to 10 h/week. There was also evidence of nonlinearity for physical activity in early pregnancy, pnonlinearity = 0.008, with no further reduction in risk above 8 h/week. There was some indication of inverse associations between walking (before and during pregnancy) and vigorous activity (before pregnancy) and the risk of gestational diabetes mellitus. This meta-analysis suggests that there is a significant inverse association between physical activity before pregnancy and in early pregnancy and the risk of gestational diabetes mellitus. Further studies are needed to clarify the association between specific types and intensities of activity and gestational diabetes mellitus.</td></tr>
<tr><td>Timeframe: Inception–August 2015</td></tr>
<tr><td>Total # of Studies: 26</td></tr>
<tr><td>Exposure Definition: PA before or during pregnancy. PA includes aerobic training, strength training, balance exercises, aquatic training, and flexibility training. Intensity was measured by metabolic equivalent hours per week.
Measures Steps: No
Measures Bouts: No
Examines HIIT: No</td></tr>
<tr><td>Outcomes Addressed: Relative risk of gestational diabetes or abnormal glucose tolerance.
Examine Cardiorespiratory Fitness as Outcome: No</td><td></td></tr>
<tr><td>Populations Analyzed: Female, Pregnant</td><td>Author-Stated Funding Source: Central Norway Regional Health Authority, Norwegian University of Science and Technology, Imperial College National Institute of Health Research Biomedical Research Centre.</td></tr>
</table>

<table>
<tr><td colspan="2">Meta-Analysis
Citation: da Silva SG, Ricardo LI, Evenson KR, Hallal PC. Leisure-time physical activity in pregnancy and maternal-child health: a systematic review and meta-analysis of randomized controlled trials and cohort studies. Sports Med. 2017;47(2):295–317. doi:10.1007/s40279-016-0565-2.</td></tr>
<tr><td>Purpose: To compare associations between leisure time physical activity (LTPA) in pregnancy and maternal and child health outcomes.</td><td rowspan="4">Abstract: BACKGROUND: Evidence suggests that leisure-time physical activity (LTPA) during pregnancy is associated with a reduced risk of preeclampsia, gestational diabetes mellitus (GDM), and preterm birth. However, these results are inconsistent when comparing cohort studies and randomized controlled trials (RCTs). OBJECTIVE: The purpose of our study was to compare the associations between LTPA in pregnancy and maternal (GDM, preeclampsia, and weight gain during pregnancy) and child health outcomes (preterm birth, birthweight, and fetal growth) between RCTs and cohort studies. METHODS: We performed a systematic search in PubMed, Web of Science, and EBSCO up to 31 August 2015. Inclusion criteria for experimental studies required randomized trials with a control group and exposure to a physical activity structured program. The inclusion criteria for cohort studies required information on LTPA during pregnancy as an exposure and at least one maternal-child health outcome. We assessed the methodological quality of all studies and performed a meta-analysis to produce summary estimates of the effects using random models. RESULTS: We included 30 RCTs and 51 cohort studies. The meta-analysis of RCTs indicated that participation in LTPA was associated with lower weight gain during pregnancy, lower likelihood of GDM, and lower likelihood of delivering a large-for-gestational-age infant. Cohort studies indicated that participation in LTPA was associated with lower weight gain during pregnancy, lower likelihood of GDM, and lower risk of preterm delivery. CONCLUSIONS: Our findings support the promotion of LTPA in pregnancy as a strategy to improve maternal and child health.</td></tr>
<tr><td>Timeframe: Inecption–August 2015</td></tr>
<tr><td>Total # of Studies: 81</td></tr>
<tr><td>Exposure Definition: LTPA: Randomized control trials assessed structured exercise programs including moderate-intensity physical activities, most including aerobic exercises and strength training. The duration of the sessions varied between 20 and 70 minutes. Cohort studies assessed PA by self report and accelerometer wear.
Measures Steps: No
Measures Bouts: No
Examines HIIT: No</td></tr>
<tr><td>Outcomes Addressed: Excessive gestational weight gain. Gestational diabetes. Pre-eclampsia. Birth weight. Fetal growth. Gestational age.
Examine Cardiorespiratory Fitness as Outcome: No</td></tr>
<tr><td>Populations Analyzed: Female, Pregnant</td><td>Author-Stated Funding Source: Not reported.</td></tr>
</table>

Meta-Analysis

Citation: Di Mascio D, Magro-Malosso ER, Saccone G, Marhefka GD, Berghella V. Exercise during pregnancy in normal-weight women and risk of preterm birth: a systematic review and meta-analysis of randomized controlled trials. *Am J Obstet Gynecol*. 2016;215(5):561–571. doi:10.1016/j.ajog.2016.06.014.

Purpose: To evaluate the effects of exercise during pregnancy on the risk of preterm birth.

Timeframe: Inception–April 2016

Total # of Studies: 9

Exposure Definition: Aerobic exercise regimens. Exercises included cycling, hydrotherapy, resistance exercises, and aerobic dance. Duration ranged from 35 to 60 minutes and frequency ranged from 3 to 4 days a week. Intensity of exercise, measured by heart rate (HR), ranged from <60% of age predicted max HR to <80%.
Measures Steps: No
Measures Bouts: No
Examines HIIT: No

Outcomes Addressed: Incidence of preterm birth <37 weeks. Relative risk or mean difference of gestational age at delivery, spontaneous vaginal delivery, operative vaginal delivery, cesarean delivery, gestational diabetes, hypertensive disorders (defined as gestational

Abstract: BACKGROUND: Preterm birth is the major cause of perinatal mortality in the United States. In the past, pregnant women have been recommended to not exercise because of presumed risks of preterm birth. Physical activity has been theoretically related to preterm birth because it increases the release of catecholamines, especially norepinephrine, which might stimulate myometrial activity. Conversely, exercise may reduce the risk of preterm birth by other mechanisms such as decreased oxidative stress or improved placenta vascularization. Therefore, the safety of exercise regarding preterm birth and its effects on gestational age at delivery remain controversial. OBJECTIVE: The objective of the study was to evaluate the effects of exercise during pregnancy on the risk of preterm birth. DATA SOURCES: MEDLINE, EMBASE, Web of Sciences, Scopus, ClinicalTrial.gov, OVID, and Cochrane Library were searched from the inception of each database to April 2016. STUDY DESIGN: Selection criteria included only randomized clinical trials of pregnant women randomized before 23 weeks to an aerobic exercise regimen or not. Types of participants included women of normal weight with uncomplicated, singleton pregnancies without any obstetric contraindication to physical activity. The summary measures were reported as relative risk or as mean difference with 95% confidence intervals. The primary outcome was the incidence of preterm birth <37 weeks. TABULATION, INTEGRATION, AND RESULTS: Of the 2059 women included in the meta-analysis, 1022 (49.6%) were randomized to the exercise group and 1037 (50.4%) to the control group. Aerobic exercise lasted about 35-90 minutes 3-4 times per week. Women who were randomized to aerobic exercise had a similar incidence of preterm birth of <37 weeks (4.5% vs 4.4%; relative risk, 1.01, 95% confidence interval, 0.68-1.50) and a similar mean gestational age at delivery (mean difference, 0.05 week, 95% confidence interval, -0.07 to 0.17) compared with controls. Women in the exercise group had a significantly higher incidence of vaginal delivery (73.6% vs 67.5%; relative risk, 1.09, 95% confidence interval, 1.04-1.15) and a significantly lower incidence of cesarean delivery (17.9% vs 22%; relative risk, 0.82, 95% confidence interval, 0.69-0.97) compared with controls. The incidence of operative vaginal delivery (12.9% vs 16.5%; relative risk, 0.78, 95% confidence interval, 0.61-1.01) was similar in both groups. Women in the exercise group had a significantly lower incidence of gestational diabetes mellitus (2.9% vs 5.6%; relative risk, 0.51, 95% confidence interval, 0.31-0.82) and a significantly lower incidence of hypertensive disorders (1.0% vs 5.6%; relative risk, 0.21, 95% confidence interval, 0.09-0.45) compared with controls. No differences in low birthweight (5.2% vs 4.7%; relative risk, 1.11, 95% confidence interval, 0.72-1.73) and mean birthweight (mean difference, -10.46 g, 95% confidence interval, -47.10 to 26.21) between the exercise group and controls were

hypertension or preeclampsia). Neonatal outcomes including birthweight and low birthweight. **Examine Cardiorespiratory Fitness as Outcome:** No	found. CONCLUSION: Aerobic exercise for 35-90 minutes 3-4 times per week during pregnancy can be safely performed by normal-weight women with singleton, uncomplicated gestations because this is not associated with an increased risk of preterm birth or with a reduction in mean gestational age at delivery. Exercise was associated with a significantly higher incidence of vaginal delivery and a significantly lower incidence of cesarean delivery, with a significantly lower incidence of gestational diabetes mellitus and hypertensive disorders and therefore should be encouraged.
Populations Analyzed: Female, Normal/Healthy Weight (BMI: 18.5–24.9), Pregnant	**Author-Stated Funding Source:** Not reported.

<table>
<tr><td colspan="2">Meta-Analysis
Citation: DiNallo JM, Downs DS. The role of exercise in preventing and treating gestational diabetes: a comprehensive review and recommendations for future research. J Appl Biobehav Res. 2008;12(3-4):141–177. doi:10.1111/j.1751-9861.2008.00019.x.</td></tr>
<tr><td>Purpose: To conduct an extensive review of the exercise and gestational diabetes mellitus literature and provide recommendations for future research.</td><td rowspan="4">Abstract: The purposes of this study were to extensively review the gestational diabetes mellitus (GDM) and exercise literature and to provide recommendations for future research. We found (1) that exercise improved glucose utilization, decreased the need for insulin, or increased cardiorespiratory fitness in 62% of the intervention/treatment studies; (2) that pre-pregnancy exercise was associated with GDM risk reduction in 45% of the correlational studies; (3) a greater risk reduction for overweight women in 27% of the correlational studies; and (4) a lack of consistency in reporting study characteristics and outcomes across all study types. Findings illustrate the positive effect of exercise on GDM outcomes, and the need for more consistency in data reporting across studies to systematically determine the protective mechanism and causal pathway of exercise for preventing GDM.</td></tr>
<tr><td>Timeframe: Not reported</td></tr>
<tr><td>Total # of Studies: 24</td></tr>
<tr><td>Exposure Definition: Self-reported PA that utilized walking, stair-climbing, and lifestyle activities were most common. Interventions demonstrated a mean duration of 78 days with exercise performed approximately 3 days/week for 33 minutes a day at a mean of 54% of maximal oxygen consumption.
Measures Steps: No
Measures Bouts: No
Examines HIIT: No</td></tr>
<tr><td>Outcomes Addressed: Risk of gestational diabetes mellitus development. Risk of abnormal glucose tolerance. Average weight increase/week (kg). Infant birth weight. Mean gestational age at delivery.
Examine Cardiorespiratory Fitness as Outcome: No</td></tr>
<tr><td>Populations Analyzed: Female, 19–48, Pregnant</td><td>Author-Stated Funding Source: National Institutes of Health</td></tr>
</table>

Systematic Review **Citation:** Dode MA, dos Santos IS. Non classical risk factors for gestational diabetes mellitus: a systematic review of the literature. *Cad Saude Publica*. 2009;25(suppl 3):S341–S359.	
Purpose: To evaluate the recent literature in order to establish whether all women presenting with these risk factors should be screened for gestational diabetes mellitus.	**Abstract:** Age, obesity and family history of diabetes are well known risk factors for gestational diabetes mellitus. Others are more controversial. The objective of this review is to find evidence in the literature that justifies the inclusion of these other conditions among risk factors. The MEDLINE, Cochrane, LILACS and Pan American Health Organization databases were searched, covering articles dating from between 1992 and 2006. Keywords were used in combination (AND) with gestational diabetes mellitus separately and with each one of the risk factors studied. The methodological quality of the studies included was assessed, resulting in the selection of 41 papers. Most studies investigating maternal history of low birth weight, low stature, and low level of physical activity have found positive associations with gestational diabetes mellitus. Low socioeconomic levels, smoking during pregnancy, high parity, belonging to minority groups, and excessive weight gain during pregnancy presented conflicting results. Publication bias cannot be ruled out. Standardization of techniques, cutoff points for screening and diagnosis, as well as studies involving larger sample sizes would allow future meta-analyses.
Timeframe: 1992–2006	
Total # of Studies: 41 (7 only addressed PA exposure)	
Exposure Definition: PA activity before pregnancy and during pregnancy were evaluated through questionaires and other forms of self report. Types of PA included vigorous PA and recreational PA. **Measures Steps:** No **Measures Bouts:** No **Examines HIIT:** No	
Outcomes Addressed: Gestational diabetes: self report, medical record, and other various standards. **Examine Cardiorespiratory Fitness as Outcome:** No	
Populations Analyzed: Female, Pregnant	**Author-Stated Funding Source:** Not reported.

Meta-Analysis

Citation: Han S, Middleton P, Crowther CA. Exercise for pregnant women for preventing gestational diabetes mellitus. *Cochrane Database Syst Rev*. 2012;(7):Cd009021. doi:10.1002/14651858.CD009021.pub2.

Purpose: To assess the effects of physical exercise for pregnant women for preventing glucose intolerance or gestational diabetes.

Timeframe: Inception–April 2012

Total # of Studies: 5

Exposure Definition: Interventions included any types of exercise and lifestyle management (i.e., exercise advice, providing exercise sessions) for pregnant women for preventing gestational diabetes mellitus before screening tests.

Measures Steps: No

Measures Bouts: No

Examines HIIT: No

Outcomes Addressed: Incidence of gestational diabetes mellitus. Mode of birth (normal vaginal birth, operative vaginal birth, caesarean section). Perineal trauma. Pre-eclampsia. Weight gain during pregnancy. Fetal birthweight. Perinatal mortality.

Abstract: BACKGROUND: Gestational diabetes mellitus (GDM) affects a significant number of women each year. GDM is associated with a wide range of adverse outcomes for women and their babies. Recent observational studies have found physical activity during normal pregnancy decreases insulin resistance and therefore might help to decrease the risk of developing GDM. OBJECTIVES: To assess the effects of physical exercise for pregnant women for preventing glucose intolerance or GDM. SEARCH METHODS: We searched the Cochrane Pregnancy and Childbirth Group's Trials Register (2 April 2012), ClinicalTrials.gov (2 April 2012) and the WOMBAT Perinatal Trials Registry (2 April 2012). SELECTION CRITERIA: Randomised and cluster-randomised trials assessing the effects of exercise for preventing pregnancy glucose intolerance or GDM. DATA COLLECTION AND ANALYSIS: Two review authors independently assessed study eligibility, extracted data and assessed the risk of bias of included studies. MAIN RESULTS: We included five trials with a total of 1115 women and their babies (922 women and their babies contributed outcome data). Four of the five included trials had small sample sizes with one large trial that recruited 855 women and babies. All five included trials had a moderate risk of bias. When comparing women receiving additional exercise interventions with those having routine antenatal care, there was no significant difference in GDM incidence (three trials, 826 women, risk ratio (RR) 1.10, 95% confidence interval (CI) 0.66 to 1.84), caesarean section (two trials, 934 women, RR 1.33, 95% CI 0.97 to 1.84) or operative vaginal birth (two trials, 934 women, RR 0.83, 95% CI 0.58 to 1.17). No trial reported the infant primary outcomes prespecified in the review.None of the five included trials found significant differences in insulin sensitivity. Evidence from one single large trial suggested no significant difference in the incidence of developing pregnancy hyperglycaemia not meeting GDM diagnostic criteria, pre-eclampsia or admission to neonatal ward between the two study groups. Babies born to women receiving exercise interventions had a non-significant trend to a lower ponderal index (mean difference (MD) -0.08 gram x 100 m(3), 95% CI -0.18 to 0.02, one trial, 84 infants). No significant differences were seen between the two study groups for the outcomes of birthweight (two trials, 167 infants, MD -102.87 grams, 95% CI -235.34 to 29.60), macrosomia (two trials, 934 infants, RR 0.91, 95% CI 0.68 to 1.22), or small-for-gestational age (one trial, 84 infants, RR 1.05, 95% CI 0.25 to 4.40) or gestational age at birth (two trials, 167 infants, MD -0.04 weeks, 95% CI -0.37 to 0.29) or Apgar score less than seven at five minutes (two trials, 919 infants, RR 1.00, 95% CI 0.27 to 3.65). None of the trials reported long-term outcomes for women and their babies. No information was available on health services costs. AUTHORS' CONCLUSIONS: There is limited randomised controlled trial evidence available on the effect of exercise during pregnancy for preventing pregnancy glucose intolerance or GDM. Results from three randomised trials with moderate risk of bias suggested no significant difference in GDM incidence between women

Examine Cardiorespiratory Fitness as Outcome: No	receiving an additional exercise intervention and routine care.Based on the limited data currently available, conclusive evidence is not available to guide practice. Larger, well-designed randomised trials, with standardised behavioural interventions are needed to assess the effects of exercise on preventing GDM and other adverse pregnancy outcomes including large-for-gestational age and perinatal mortality. Longer-term health outcomes for both women and their babies and health service costs should be included. Several such trials are in progress. We identified another seven trials which are ongoing and we will consider these for inclusion in the next update of this review.
Populations Analyzed: Female, Adults, Pregnant	**Author-Stated Funding Source:** Australian Research Centre for Health of Women and Babies, Robinson Institute, The University of Adelaide, Australian Department of Health and Ageing, National Health and Medical Research Council.

<table>
<tr><td colspan="2">Meta-Analysis
Citation: Madhuvrata P, Govinden G, Bustani R, Song S, Farrell TA. Prevention of gestational diabetes in pregnant women with risk factors for gestational diabetes: a systematic review and meta-analysis of randomised trials. Obstet Med. 2015;8(2):68–85. doi:10.1177/1753495X15576673.</td></tr>
<tr><td>Purpose: To see if there is any intervention that can be used for primary prevention of gestational diabetes mellitus (GDM) in women with risk factors of GDM.</td><td rowspan="4">Abstract: BACKGROUND: Gestational diabetes mellitus can be defined as 'glucose intolerance or hyperglycaemia with onset or first recognition during pregnancy.' OBJECTIVE: The objective of our systematic review was to see if there was any intervention that could be used for primary prevention of gestational diabetes mellitus in women with risk factors for gestational diabetes mellitus. SEARCH STRATEGY: Major databases were searched from 1966 to Aug 2012 without language restriction. SELECTION CRITERIA: Randomised trials comparing intervention with standard care in women with risk factors for gestational diabetes were included. Meta-analysis was performed in accordance with Preferred Reporting Items for Systematic Reviews and Meta-Analysis statement. The primary outcome assessed was the incidence of gestational diabetes. DATA COLLECTION AND ANALYSIS: Data from included trials were extracted independently by two authors and analysed using Rev-Man 5. MAIN RESULTS: A total of 2422 women from 14 randomised trials were included; which compared diet (four randomised trials), exercise (three randomised trials), lifestyle changes (five randomised trials) and metformin (two randomised trials) with standard care in women with risk factors for gestational diabetes mellitus. Dietary intervention was associated with a statistically significantly lower incidence of gestational diabetes (Odds ratio 0.33, 95% CI 0.14 to 0.76) and gestational hypertension (Odds ratio 0.28, 95% CI 0.09, 0.86) compared to standard care. There was no statistically significant difference in the incidence of gestational diabetes mellitus or in the secondary outcomes with exercise, lifestyle changes or metformin use compared to standard care. CONCLUSIONS: The use of dietary intervention has shown a statistically significantly lower incidence of gestational diabetes mellitus and gestational hypertension compared to standard care in women with risk factors for gestational diabetes mellitus.</td></tr>
<tr><td>Timeframe: 1966–August 2012</td></tr>
<tr><td>Total # of Studies: 14 (3 PA exposure)</td></tr>
<tr><td>Exposure Definition:
Individualized, supervised exercise programs consisting of either aerobic and strength exercises or aerobic exercise only. Frequency ranged 2–3 days/week at 50–70% of the individual's maximum heart rate for 30–60 minutes/session.
Measures Steps: No
Measures Bouts: No
Examines HIIT: No</td></tr>
<tr><td>Outcomes Addressed: Incidence of gestational diabetes mellitus. Large for gestational age (≥90th percentile). Caesarean section. Fasting blood glucose. Mean birth weight. Macrosomia. Small for gestational age (≤10th percentile). Pre-eclampsia. Gestational hypertension. Induction of labour. Preterm birth.
Examine Cardiorespiratory Fitness as Outcome: No</td></tr>
<tr><td>Populations Analyzed: Female, Mean age 30.4, Pregnant</td><td>Author-Stated Funding Source: No funding source used.</td></tr>
</table>

<table>
<tr><td colspan="2">Meta-Analysis
Citation: Oostdam N, van Poppel MN, Wouters MG, van Mechelen W. Interventions for preventing gestational diabetes mellitus: a systematic review and meta-analysis. J Womens Health (Larchmt). 2011;20(10):1551–1563. doi:10.1089/jwh.2010.2703.</td></tr>
<tr><td>Purpose: To examine randomized control trials focusing on interventions to prevent gestational diabetes.</td><td rowspan="4">Abstract: BACKGROUND: The prevalence of gestational diabetes mellitus (GDM) is increasing worldwide. GDM is associated with increased risks for mother and child during pregnancy and in later life. The aim of this article is to systematically review literature on the effectiveness of interventions to prevent GDM. METHODS: Controlled trials found in PubMed, EMBASE, or CENTRAL were selected. The primary outcome was GDM, and relevant secondary outcomes were maternal fasting blood glucose and large-for-gestational age (LGA) or macrosomia. Data were combined in meta-analyses, and the quality of evidence for the effectiveness of the interventions was assessed in a GRADE approach. RESULTS: Nineteen studies evaluating six types of interventions were included. Dietary counseling significantly reduced GDM incidence compared to standard care. None of the interventions was effective in lowering maternal fasting blood glucose. Low glycemic index (LGI) diet advice and an exercise program significantly reduced the risk of macrosomia. The quality of evidence for these outcomes was low. CONCLUSIONS: The results indicate that there may be some benefits of dietary counseling, an LGI diet advice, or an exercise program. However, better-designed studies are required to generate higher quality evidence. At the moment, no strong conclusions can be drawn with regard to the best intervention for prevention of GDM.</td></tr>
<tr><td>Timeframe: 1980–March 2011</td></tr>
<tr><td>Total # of Studies: 19 (3 only addressing PA exposure)</td></tr>
<tr><td>Exposure Definition: Home-based stationary cycling program or resistance and toning exercise. Compared exercise program to usual care.
Measures Steps: No
Measures Bouts: No
Examines HIIT: No</td></tr>
<tr><td>Outcomes Addressed:
Gestational diabetes status.
Fasting plasma glucose.
Macrosomia: birth weight greater than 4,000 grams.
Examine Cardiorespiratory Fitness as Outcome: No</td></tr>
<tr><td>Populations Analyzed: Female, Pregnant</td><td>Author-Stated Funding Source: Netherlands Organisation for Health Research and Development.</td></tr>
</table>

Meta-Analysis

Citation: Russo LM, Nobles C, Ertel KA, Chasan-Taber L, Whitcomb BW. Physical activity interventions in pregnancy and risk of gestational diabetes mellitus: a systematic review and meta-analysis. *Obstet Gynecol.* 2015;125(3):576–582. doi:10.1097/AOG.0000000000000691.

Purpose: To summarize all available data from randomized control trials looking at the effect of PA-only interventions on the risk of gestational diabetes mellitus.

Timeframe: Inception–August 2014

Total # of Studies: 10

Exposure Definition: Interventions varied with regard to exercise type along with the frequency and intensity. Gestational age at baseline ranged from 6 to 8 weeks to 18–22 weeks. All the interventions included an aerobic component (walking; land, water aerobics, or both; cycling), and 4 included an anaerobic component (strength and balance exercises). Duration of exercise ranged from 105 to 240 minutes per week.
Measures Steps: No
Measures Bouts: No
Examines HIIT: No

Outcomes Addressed: Incidence of gestational diabetes mellitus: glucose tolerance test.
Examine Cardiorespiratory Fitness as Outcome: No

Populations Analyzed: Female, Pregnant

Abstract: OBJECTIVE: Gestational diabetes mellitus (GDM) is a common complication of pregnancy associated with an increased incidence of pregnancy complications, adverse pregnancy outcomes, and maternal and fetal risks of chronic health conditions later in life. Physical activity has been proposed to reduce the risk of GDM and is supported by observational studies, but experimental research assessing its effectiveness is limited and conflicting. We aimed to use meta-analysis to synthesize existing randomized controlled studies of physical activity and GDM. DATA SOURCES: We searched MEDLINE, Cochrane Central Register of Controlled Trials, and ClinicalTrials.gov for eligible studies. METHODS OF STUDY SELECTION: The following combination of keywords was used: (pregnant or pregnancy or gestation or gestate or gestational or maternity or maternal or prenatal) AND (exercise or locomotion or activity or training or sports) AND (diabetes or insulin sensitivity or glucose tolerance) AND (random* or trial). Eligibility was restricted to studies that randomized participants to an exercise-only-based intervention (ie, separate from dietary interventions) and presented data regarding GDM risk. Two authors performed the database search, assessment of eligibility, and abstraction of data from included studies, and a third resolved any discrepancies. A total of 469 studies was retrieved, of which 10 met inclusion criteria and could be used for analysis (3,401 participants). TABULATION, INTEGRATION, AND RESULTS: Fixed-effects models were used to estimate summary relative risk (RR) and 95% confidence interval (CI) and I to assess heterogeneity. There was a 28% reduced risk (95% CI 9-42%) in the intervention group compared with the control group (RR 0.72, P=.005). Heterogeneity was low (I=12%) and nonsignificant (P=.33). CONCLUSION: The results from this meta-analysis suggest that physical activity in pregnancy provides a slight protective effect against the development of GDM. Studies evaluating type, timing, duration, and compliance of physical activity regimens are warranted to best inform obstetric guidelines.

Author-Stated Funding Source: Not reported.

<table>
<tr><td colspan="2">Meta-Analysis
Citation: Sanabria-Martinez G, Garcia-Hermoso A, Poyatos-Leon R, Alvarez-Bueno C, Sanchez-Lopez M, Martinez-Vizcaino V. Effectiveness of physical activity interventions on preventing gestational diabetes mellitus and excessive maternal weight gain: a meta-analysis. BJOG. 2015;122(9):1167–1174. doi:10.1111/1471-0528.13429.</td></tr>
<tr><td>Purpose: To conduct a meta-analysis of randomised controlled clinical trials (RCTs) focused on assessing the effectiveness of physical exercise programs during pregnancy to prevent gestational diabetes mellitus and excessive maternal weight gain.</td><td rowspan="4">Abstract: BACKGROUND: It is commonly accepted that pregnancy-related physiological changes (circulatory, respiratory, and locomotor) negatively influence the daily physical activity of pregnant women. OBJECTIVES: The aim of this study is to conduct a meta-analysis of randomised controlled trials (RCTs) for assessing the effectiveness of physical exercise interventions during pregnancy to prevent gestational diabetes mellitus and excessive maternal weight gain. SEARCH STRATEGY: Keywords were used to conduct a computerised search in six databases: Cochrane Library Plus, Science Direct, EMBASE, PubMed, Web of Science, and ClinicalTrials.gov. SELECTION CRITERIA: Healthy pregnant women who were sedentary or had low levels of physical activity were selected for RCTs that included an exercise programme. DATA COLLECTION AND ANALYSIS: Two independent reviewers extracted data and assessed the quality of the included studies. Of 4225 articles retrieved, 13 RCTs (2873 pregnant women) met the inclusion criteria. Pooled relative risk (RR) or weighted mean differences (WMDs) (depending on the outcome measure) were calculated using a random-effects model. MAIN RESULTS: Overall, physical exercise programmes during pregnancy decreased the risk of gestational diabetes mellitus (RR = 0.69; P = 0.009), particularly when the exercise programme was performed throughout pregnancy (RR = 0.64; P = 0.038). Furthermore, decreases were also observed in maternal weight (WMD = -1.14 kg; 95% CI -1.50 to -0.78; P < 0.001). No serious adverse effects were reported. CONCLUSION: Structured moderate physical exercise programmes during pregnancy decrease the risk of gestational diabetes mellitus and diminish maternal weight gain, and seem to be safe for the mother and the neonate; however, further studies are needed to establish recommendations.</td></tr>
<tr><td>Timeframe: 1990–May 2014</td></tr>
<tr><td>Total # of Studies: 13</td></tr>
<tr><td>Exposure Definition: Exercise programs included aerobic exercises, resistance, toning, flexibility, and strength exercises, weight training. The frequency of sessions ranged from 2 to 5 per week, and the sessions lasted between 15 and 60 minutes. Intensity ranged from very light to moderate.
Measures Steps: No
Measures Bouts: No
Examines HIIT: No</td></tr>
<tr><td>Outcomes Addressed: Relative risk for gestational diabetes mellitus. Weighted mean difference for maternal weight.
Examine Cardiorespiratory Fitness as Outcome: No</td></tr>
<tr><td>Populations Analyzed: Female, Pregnant</td><td>Author-Stated Funding Source: No funding source used.</td></tr>
</table>

<table>
<tr><td colspan="2">Meta-Analysis
Citation: Song C, Li J, Leng J, Ma RC, Yang X. Lifestyle intervention can reduce the risk of gestational diabetes: a meta-analysis of randomized controlled trials. Obes Rev. 2016;17(10):960–969. doi:10.1111/obr.12442.</td></tr>
<tr><td>Purpose: To address the efficacy of lifestyle intervention during pregnancy (i.e., diet and PA) on the risk of gestational diabetes mellitus.</td><td rowspan="4">Abstract: This study aimed to examine the effect of lifestyle intervention on the risk of gestational diabetes mellitus (GDM). We searched PubMed, Springer and other databases to retrieve articles published in English and Chinese up to 30 September 2015. The inclusion criteria were randomized controlled trials evaluating the effects of lifestyle intervention on risk of GDM. Exclusion criteria were studies with prepregnancy diabetes mellitus or interventions with nutrient supplements. Random-effect and fixed-effect model analyses were used to obtain pooled relative risks and 95% confidence intervals (CIs) of diet and physical activity on the risk of GDM. Subgroup analyses were performed to check the consistency of effect sizes across groups where appropriate. We identified 29 randomized controlled trials with 11,487 pregnant women, addressing the effect of lifestyle intervention on the risk of GDM. In the pooled analysis, either diet or physical activity resulted in an 18% (95%CI 5-30%) reduction in the risk of GDM (P = 0.0091). Subgroup analysis showed that such intervention was effective among women with intervention before the 15th gestational week (relative risk: 0.80, 95%CI 0.66-0.97), but not among women receiving the intervention afterwards. We conclude that lifestyle modification during pregnancy, especially before the 15th gestational week, can reduce the risk of GDM. (c) 2016 World Obesity.</td></tr>
<tr><td>Timeframe: Inception–October 2015</td></tr>
<tr><td>Total # of Studies: 29</td></tr>
<tr><td>Exposure Definition: Lifestyle intervention, PA only or with diet, during the first two trimesters of pregnancy.
Measures Steps: No
Measures Bouts: No
Examines HIIT: No</td></tr>
<tr><td>Outcomes Addressed: Risk of gestational diabetes mellitus.
Examine Cardiorespiratory Fitness as Outcome: No</td></tr>
<tr><td>Populations Analyzed: Female, Adults <30, ≥30, Normal/Healthy Weight (BMI: 18.5–24.9), Overweight and Obese, Pregnant</td><td>Author-Stated Funding Source: None.</td></tr>
</table>

<table>
<tr><td colspan="2">Meta-Analysis
Citation: Tobias DK, Zhang C, van Dam RM, Bowers K, Hu FB. Physical activity before and during pregnancy and risk of gestational diabetes mellitus: a meta-analysis. Diabetes Care. 2011;34(1):223–229. doi:10.2337/dc10-1368.</td></tr>
<tr><td>Purpose: To assemble the current evidence for the relationship between PA and the development of gestational diabetes.</td><td rowspan="4">Abstract: OBJECTIVE: Gestational diabetes mellitus (GDM) is one of the most common complications of pregnancy and is associated with a substantially elevated risk of adverse health outcomes for both mothers and offspring. Physical activity may contribute to the prevention of GDM and thus is crucial for dissecting the vicious circle involving GDM, childhood obesity, and adulthood obesity, and diabetes. Therefore, we aimed to systematically review and synthesize the current evidence on the relation between physical activity and the development of GDM. RESEARCH DESIGN AND METHODS: Medline, EMBASE, and Cochrane Reviews were searched from inception to 31 March 2010. Studies assessing the relationship between physical activity and subsequent development of GDM were included. Characteristics including study design, country, GDM diagnostic criteria, ascertainment of physical activity, timing of exposure (prepregnancy or early pregnancy), adjusted relative risks, CIs, and statistical methods were extracted independently by two reviewers. RESULTS: Our search identified seven prepregnancy and five early pregnancy studies, including five prospective cohorts, two retrospective case-control studies, and two cross-sectional study designs. Prepregnancy physical activity was assessed in 34,929 total participants, which included 2,813 cases of GDM, giving a pooled odds ratio (OR) of 0.45 (95% CI 0.28-0.75) when the highest versus lowest categories were compared. Exercise in early pregnancy was assessed in 4,401 total participants, which included 361 cases of GDM, and was also significantly protective (0.76 [95% CI 0.70-0.83]). CONCLUSIONS: Higher levels of physical activity before pregnancy or in early pregnancy are associated with a significantly lower risk of developing GDM.</td></tr>
<tr><td>Timeframe: Inception–March 2010</td></tr>
<tr><td>Total # of Studies: 8 (5 assessed pregnancy)</td></tr>
<tr><td>Exposure Definition: PA was assessed through questionnaires and interviews. Types of PA included total PA and specific activities performed. Subgroups included total PA, walking, stair climbing, vigorous activity, and physical inactivity.
Measures Steps: No
Measures Bouts: No
Examines HIIT: No</td></tr>
<tr><td>Outcomes Addressed:
Gestational diabetes diagnosis: specific diagnostic criteria or self report.
Examine Cardiorespiratory Fitness as Outcome: No</td></tr>
<tr><td>Populations Analyzed: Female, Pregnant</td><td>Author-Stated Funding Source: National Institutes of Health.</td></tr>
</table>

<table>
<tr><td colspan="2">Meta-Analysis
Citation: Yin YN, Li XL, Tao TJ, Luo BR, Liao SJ. Physical activity during pregnancy and the risk of gestational diabetes mellitus: a systematic review and meta-analysis of randomised controlled trials. Br J Sports Med. 2014;48(4):290–295. doi:10.1136/bjsports-2013-092596.</td></tr>
<tr><td>Purpose: To collect all the evidence available from randomised controlled trials regarding the association between physical exercise during pregnancy and the incidence of gestational diabetes mellitus to assess the effects of physical exercise for preventing gesta</td><td rowspan="5">Abstract: OBJECTIVES: We performed a systematic review and meta-analysis to assess the effects of physical activity in preventing gestational diabetes mellitus (GDM). SEARCH STRATEGY: We searched the literature in six electronic databases and bibliographies of relevant articles. SELECTION CRITERIA: We included randomised controlled trials on pregnant women who did not have GDM and other complications previously and had increased physical activity as the only intervention. The risk of developing GDM was documented separately for the intervention and control groups. DATA COLLECTION AND ANALYSIS: Two reviewers extracted data and assessed quality independently. Data from the included trials were combined using a fixed-effects model. The effect size was expressed as relative risk (RR) and 95% CI. MAIN RESULTS: Of the 1110 studies identified, six randomised controlled trials met the inclusion criteria. In three trials, the incidence of GDM was lower in the intervention group than in the control group, whereas two trials showed a higher incidence of GDM in the intervention group and the remaining trial found no GDM in either the intervention or control group. The meta-analysis resulted in a relative risk (RR) of GDM of 0.91 (95% CI 0.57 to 1.44), suggesting no significant difference in the risk of developing GDM between the intervention and the control groups. No indication of publication bias was found. CONCLUSIONS: Evidence was insufficient to suggest that physical activity during pregnancy might be effective to lower the risk of developing GDM.</td></tr>
<tr><td>Timeframe: 1966–April 2013</td></tr>
<tr><td>Total # of Studies: 6</td></tr>
<tr><td>Exposure Definition: Interventions varied by their beginning gestation weeks (6–18 weeks), intensity, duration (12–32 weeks), and types of activity. Calculated metabolic equivalents (METs) for energy expenditure according to the Compendium of Physical Activities Tracking Guide. All interventions translated into METs per intervention in the range 9,300–27,772.5. All interventions persisted to the third trimester or until delivery.
Measures Steps: No
Measures Bouts: No
Examines HIIT: No</td></tr>
<tr><td>Outcomes Addressed: Incidence of gestational diabetes mellitus.
Examine Cardiorespiratory Fitness as Outcome: No</td></tr>
<tr><td>Populations Analyzed: Female, Pregnant</td><td>Author-Stated Funding Source: Not reported.</td></tr>
</table>

<table>
<tr><td colspan="2">Meta-Analysis
Citation: Yu Y, Xie R, Shen C, Shu L. Effect of exercise during pregnancy to prevent gestational diabetes mellitus: a systematic review and meta-analysis. J Matern Fetal Neonatal Med. May 2017:1–6. doi:10.1080/14767058.2017.1319929.</td></tr>
<tr><td>Purpose: To investigate the effect of exercise during pregnancy on gestational diabetes mellitus.</td><td rowspan="5">Abstract: INTRODUCTION: Exercise showed some potential in preventing gestational diabetes mellitus. However, the results remained controversial. We conducted a systematic review and meta-analysis to evaluate the impact of exercise during pregnancy on gestational diabetes mellitus. METHODS: PubMed, EMbase, Web of science, EBSCO, and Cochrane library databases were systematically searched. Randomized controlled trials (RCTs) assessing the influence of exercise during pregnancy on gestational diabetes mellitus were included. Two investigators independently searched articles, extracted data, and assessed the quality of included studies. The primary outcome was the incidence of gestational diabetes mellitus. Meta-analysis was performed using random-effect model. RESULTS: Six RCTs involving 2164 patients were included in the meta-analysis. Compared with control intervention, exercise intervention was associated with significantly decreased incidence of gestational diabetes mellitus (Std. mean difference = 0.59; 95% CI = 0.39 to 0.88; P = 0.01), but had no effect on gestational age at birth (Std. mean difference=-0.03; 95% CI=-0.12 to 0.07; P = 0.60), the number of preterm birth (OR = 0.85; 95% CI = 0.43 to 1.66; P = 0.63), glucose 2-h post-OGTT (Std. mean difference=-1.02; 95% CI=-2.75 to 0.71; P = 0.25), birth weight (Std. mean difference=-0.13; 95% CI=-0.26 to 0.01; P = 0.06), and Apgar score less than 7 (OR = 0.78; 95% CI = 0.21 to 2.91; P = 0.71). CONCLUSIONS: Compared to control intervention, exercise intervention could significantly decrease the risk of gestational diabetes mellitus, but showed no impact on gestational age at birth, preterm birth, glucose 2-h post-OGTT, birth weight and Apgar score less than 7.</td></tr>
<tr><td>Timeframe: Inception–March 2017</td></tr>
<tr><td>Total # of Studies: 6</td></tr>
<tr><td>Exposure Definition: PA was reported as a supervised cycling program 3 times per week in 2 of the studies. The other three obtained PA based on the American College of Obstetricians and Gynecologists guidelines.
Measures Steps: No
Measures Bouts: No
Examines HIIT: No</td></tr>
<tr><td>Outcomes Addressed: Incidence of gestational diabetes mellitus. Gestational age at birth. Incidence of preterm birth. Glucose 2 hours post oral glucose tolerance test. Birth weight. Apgar score less than 7.
Examine Cardiorespiratory Fitness as Outcome: No</td></tr>
<tr><td>Populations Analyzed: Female, Pregnant</td><td>Author-Stated Funding Source: Not reported.</td></tr>
</table>

<table>
<tr><td colspan="2">Meta-Analysis
Citation: Zheng J, Wang H, Ren M. Influence of exercise intervention on gestational diabetes mellitus: a systematic review and meta-analysis. J Endocrinol Invest. April 2017. doi:10.1007/s40618-017-0673-3.</td></tr>
<tr><td>Purpose: To investigate the influence of exercise intervention on gestational diabetes mellitus.</td><td rowspan="4">Abstract: AIMS: Exercise intervention might be a promising approach to prevent gestational diabetes mellitus. However, the results remained controversial. We conducted a systematic review and meta-analysis to explore the effect of exercise intervention on gestational diabetes mellitus. METHODS: PubMed, EMbase, Web of science, EBSCO, and Cochrane library databases were systematically searched. Randomized controlled trials (RCTs) assessing the effect of exercise intervention on gestational diabetes mellitus were included. Two investigators independently searched articles, extracted data, and assessed the quality of included studies. The primary outcome was the incidence of gestational diabetes mellitus, preterm birth, and gestational age at birth. Meta-analysis was performed using random-effect model. RESULTS: Five RCTs involving 1872 patients were included in the meta-analysis. Overall, compared with control intervention, exercise intervention was found to significantly reduce the risk of gestational diabetes mellitus (std. mean difference 0.62; 95% CI 0.43-0.89; P = 0.01), but demonstrated no influence on preterm birth (OR 0.93; 95% CI 0.44-1.99; P = 0.86), gestational age at birth (std. mean difference -0.03; 95% CI -0.12 to 0.07; P = 0.60), glucose 2-h post-OGTT (std. mean difference -1.02; 95% CI -2.75 to 0.71; P = 0.25), birth weight (std. mean difference -0.10; 95% CI -0.25 to 0.04; P = 0.16), Apgar score less than 7 (OR 0.78; 95% CI 0.21-2.91; P = 0.71), and preeclampsia (OR 1.05; 95% CI 0.53-2.07; P = 0.88). CONCLUSIONS: Compared to control intervention, exercise intervention was found to significantly reduce the incidence of gestational diabetes mellitus, but had no significant influence on preterm birth, gestational age at birth, glucose 2-h post-OGTT, birth weight, Apgar score less than 7, and preeclampsia.</td></tr>
<tr><td>Timeframe: Inception–December 2016</td></tr>
<tr><td>Total # of Studies: 5</td></tr>
<tr><td>Exposure Definition: PA at 10–22 weeks of pregnancy was reported as a supervised cycling program 3 times per week in two of the studies. The other 3 obtained PA based on the American College of Obstetricians and Gynecologists guidelines.
Measures Steps: No
Measures Bouts: No
Examines HIIT: No</td></tr>
<tr><td>Outcomes Addressed: Incidence of gestational diabetes mellitus. Preterm birth. Gestational age at birth (day). Glucose 2-hour post-oral glucose tolerance test. Birth weight (g). Apgar score < 7. Pre-eclampsia.
Examine Cardiorespiratory Fitness as Outcome: No</td></tr>
<tr><td>Populations Analyzed: Female, Pregnant</td><td>Author-Stated Funding Source: Not reported.</td></tr>
</table>

Table 3. Existing Systematic Review and Meta-Analyses Quality Assessment Chart

	Aune, 2016	da Silva, 2017	Di Mascio, 2016	DiNallo, 2008	Dode, 2009	Han, 2012
Review questions and inclusion/exclusion criteria delineated prior to executing search strategy.	Yes	Yes	Yes	No	Yes	Yes
Population variables defined and considered in methods.	Yes	No	Yes	Yes	Yes	Yes
Comprehensive literature search performed.	Yes	Yes	Yes	Yes	No	Yes
Duplicate study selection and data extraction performed.	Yes	Yes	Yes	No	No	Yes
Search strategy clearly described.	Yes	Yes	Yes	No	Yes	Yes
Relevant grey literature included in review.	No	Yes	Yes	Yes	No	Yes
List of studies (included and excluded) provided.	Yes	No	No	No	No	Yes
Characteristics of included studies provided.	Yes	Yes	Yes	Yes	Yes	Yes
FITT defined and examined in relation to outcome effect sizes.	Yes	No	Yes	No	N/A	No
Scientific quality (risk of bias) of included studies assessed and documented.	Yes	Yes	Yes	No	Yes	Yes
Results depended on study quality, either overall, or in interaction with moderators.	Yes	No	Yes	N/A	Yes	Yes
Scientific quality used appropriately in formulating conclusions.	Yes	Yes	Yes	N/A	Yes	Yes
Data appropriately synthesized and if applicable, heterogeneity assessed.	Yes	Yes	Yes	No	N/A	Yes
Effect size index chosen justified, statistically.	Yes	Yes	Yes	Yes	N/A	Yes
Individual-level meta-analysis used.	No	No	No	No	N/A	No
Practical recommendations clearly addressed.	Yes	Yes	Yes	Yes	Yes	Yes
Likelihood of publication bias assessed.	Yes	No	Yes	No	Yes	No
Conflict of interest disclosed.	Yes	Yes	Yes	No	No	Yes

	Madhuvrata, 2015	Oostdam, 2011	Russo, 2015	Sanabria-Martinez, 2015	Song, 2016	Tobias, 2011
Review questions and inclusion/exclusion criteria delineated prior to executing search strategy.	Yes	Yes	Yes	Yes	Yes	Yes
Population variables defined and considered in methods.	No	No	No	No	Yes	Yes
Comprehensive literature search performed.	Yes	Yes	Partially Yes	Yes	Yes	Yes
Duplicate study selection and data extraction performed.	Yes	Yes	No	Yes	Yes	Yes
Search strategy clearly described.	Yes	No	Yes	Yes	Yes	Yes
Relevant grey literature included in review.	Yes	Yes	Yes	Yes	Yes	No
List of studies (included and excluded) provided.	Yes	No	No	No	No	No
Characteristics of included studies provided.	Yes	Yes	Yes	Yes	No	Yes
FITT defined and examined in relation to outcome effect sizes.	No	No	No	Yes	No	Yes
Scientific quality (risk of bias) of included studies assessed and documented.	Yes	Yes	Partially Yes	Yes	Partially Yes	Yes
Results depended on study quality, either overall, or in interaction with moderators.	No	Yes	Yes	Yes	No	Yes
Scientific quality used appropriately in formulating conclusions.	No	Yes	Yes	Yes	Yes	Yes
Data appropriately synthesized and if applicable, heterogeneity assessed.	Yes	Yes	Yes	Yes	Yes	Yes
Effect size index chosen justified, statistically.	Partially Yes	Yes	Partially Yes	Yes	Yes	Yes
Individual-level meta-analysis used.	No	No	No	No	No	No
Practical recommendations clearly addressed.	Yes	Yes	Yes	Yes	Yes	Yes
Likelihood of publication bias assessed.	No	No	Yes	Yes	Yes	Yes
Conflict of interest disclosed.	Yes	Yes	No	Yes	Yes	Yes

	Yin, 2014	Yu, 2017	Zheng, 2017
Review questions and inclusion/exclusion criteria delineated prior to executing search strategy.	Yes	Yes	Yes
Population variables defined and considered in methods.	No	No	No
Comprehensive literature search performed.	Yes	Yes	Yes
Duplicate study selection and data extraction performed.	Yes	No	No
Search strategy clearly described.	Yes	Yes	Yes
Relevant grey literature included in review.	No	Yes	Yes
List of studies (included and excluded) provided.	Yes	No	No
Characteristics of included studies provided.	Yes	No	No
FITT defined and examined in relation to outcome effect sizes.	Yes	No	No
Scientific quality (risk of bias) of included studies assessed and documented.	Yes	Yes	Yes
Results depended on study quality, either overall, or in interaction with moderators.	Yes	No	No
Scientific quality used appropriately in formulating conclusions.	Yes	No	No
Data appropriately synthesized and if applicable, heterogeneity assessed.	Yes	Yes	Yes
Effect size index chosen justified, statistically.	Yes	Yes	Yes
Individual-level meta-analysis used.	No	No	No
Practical recommendations clearly addressed.	Yes	Yes	Yes
Likelihood of publication bias assessed.	Yes	No	No
Conflict of interest disclosed.	No	No	No

Appendices

Appendix A: Analytical Framework

Topic Area
Pregnancy and Postpartum

Systematic Review Questions
What is the relationship between physical activity and the incidence of gestational diabetes mellitus?

a. What dose of physical activity is associated with the reported quantitative benefit or risk?
b. Is there a dose-response relationship? If yes, what is the shape of the relationship?
c. Does the relationship vary by age, race/ethnicity, socio-economic status, or weight status?

Population
Pregnant adolescents and women and postpartum

Exposure
All types and intensities of physical activity, including lifestyle activities, leisure activities, and sedentary behavior

Comparison
Pregnant adolescents and women and postpartum mothers who participate in varying levels of physical activity, including no reported physical activity

Endpoint Health Outcomes
Gestational diabetes mellitus

Key Definitions
- Postpartum period: Date of birth through one year after birth

Appendix B: Final Search Strategy

Search Strategy: PubMed (Systematic Reviews, Meta-Analyses, Pooled Analyses, and High-Quality Reports)

Database: PubMed; Date of Search: 8/22/17; 27 results (18 results already in database, 9 unique results)

Set	Search Strategy
Limit: Date	("2006/01/01"[PDAT] : "3000/12/31"[PDAT])
Limit: Language	AND (English[lang])
Limit: Exclude animal only	NOT ("Animals"[Mesh] NOT ("Animals"[Mesh] AND "Humans"[Mesh]))
Limit: Publication Type Include (Systematic Reviews/Meta-Analyses)	AND (systematic[sb] OR meta-analysis[pt] OR "systematic review"[tiab] OR "systematic literature review"[tiab] OR metaanalysis[tiab] OR "meta analysis"[tiab] OR metanalyses[tiab] OR "meta analyses"[tiab] OR "pooled analysis"[tiab] OR "pooled analyses"[tiab] OR "pooled data"[tiab])
Limit: Publication Type Exclude (Systematic Reviews/Meta-Analyses)	NOT ("comment"[Publication Type] OR "editorial"[Publication Type])
Physical Activity	AND (("Aerobic endurance"[tiab] OR "Bicycl*"[tiab] OR "Endurance training"[tiab] OR "Exercise"[mh] OR "Exercise"[tiab] OR "Exercises"[tiab] OR "Free living activities"[tiab] OR "Free living activity"[tiab] OR "Functional training"[tiab] OR "Leisure-time physical activity"[tiab] OR "Lifestyle activities"[tiab] OR "Lifestyle activity"[tiab] OR "Muscle stretching exercises"[mh] OR "Physical activity"[tiab] OR "Qi gong"[tiab] OR "Recreational activities"[tiab] OR "Recreational activity"[tiab] OR "Resistance training"[tiab] OR "Running"[tiab] OR "Sedentary lifestyle"[mh] OR "Speed training"[tiab] OR "Strength training"[tiab] OR "Tai chi"[tiab] OR "Tai ji"[mh] OR "Tai ji"[tiab] OR "Training duration"[tiab] OR "Training frequency"[tiab] OR "Training intensity"[tiab] OR "Treadmill"[tiab] OR "Walking"[tiab] OR "Weight lifting"[tiab] OR "Weight training"[tiab] OR "Yoga"[mh] OR "Yoga"[tiab]) OR (("Aerobic activities"[tiab] OR "Aerobic activity"[tiab] OR "Cardiovascular activities"[tiab] OR "Cardiovascular activity"[tiab] OR "Endurance activities"[tiab] OR "Endurance activity"[tiab] OR "Physical activities"[tiab] OR "Physical conditioning"[tiab] OR "Sedentary"[tiab]) NOT medline[sb]))
Outcome	AND ("eclampsia"[tiab] OR "pre-eclampsia"[tiab] OR "pre-eclampsia"[mh] OR "preeclampsia"[tiab])

Search Strategy: CINAHL (Systematic Reviews, Meta-Analyses, Pooled Analyses, and High-Quality Reports)

Database: CINAHL; Date of Search: 8/20/2017; 10 results (0 unique results)
Terms searched in title or abstract

Set	Search Strategy
Physical Activity	("Aerobic endurance" OR "Bicycl*" OR "Endurance training" OR "Exercise" OR "Exercises" OR "Free living activities" OR "Free living activity" OR "Functional training" OR "Leisure-time physical activity" OR "Lifestyle activities" OR "Lifestyle activity" OR "Muscle stretching exercises" OR "Physical activity" OR "Qi gong" OR "Recreational activities" OR "Recreational activity" OR "Resistance training" OR "Running" OR "Sedentary lifestyle" OR "Speed training" OR "Strength training" OR "Tai chi" OR "Tai ji" OR "Tai ji" OR "Training duration" OR "Training frequency" OR "Training intensity" OR "Treadmill" OR "Walking" OR "Weight lifting" OR "Weight training" OR "Yoga" OR "Aerobic activities" OR "Aerobic activity" OR "Cardiovascular activities" OR "Cardiovascular activity" OR "Endurance activities" OR "Endurance activity" OR "Physical activities" OR "Physical conditioning" OR "Sedentary")
Outcomes	("eclampsia" OR "pre-eclampsia" OR "preeclampsia")
Systematic Reviews and Meta-Analyses	("systematic review" OR "systematic literature review" OR metaanalysis OR "meta analysis" OR metanalyses OR "meta analyses" OR "pooled analysis" OR "pooled analyses" OR "pooled data")
Limits	2006–April 2017 English language Peer reviewed Exclude Medline records Human

Search Strategy: Cochrane (Systematic Reviews, Meta-Analyses, Pooled Analyses, and High-Quality Reports)

Database: Cochrane; Date of Search: 8/20/17; 10 results (0 unique results)
Terms searched in title, abstract, or keywords

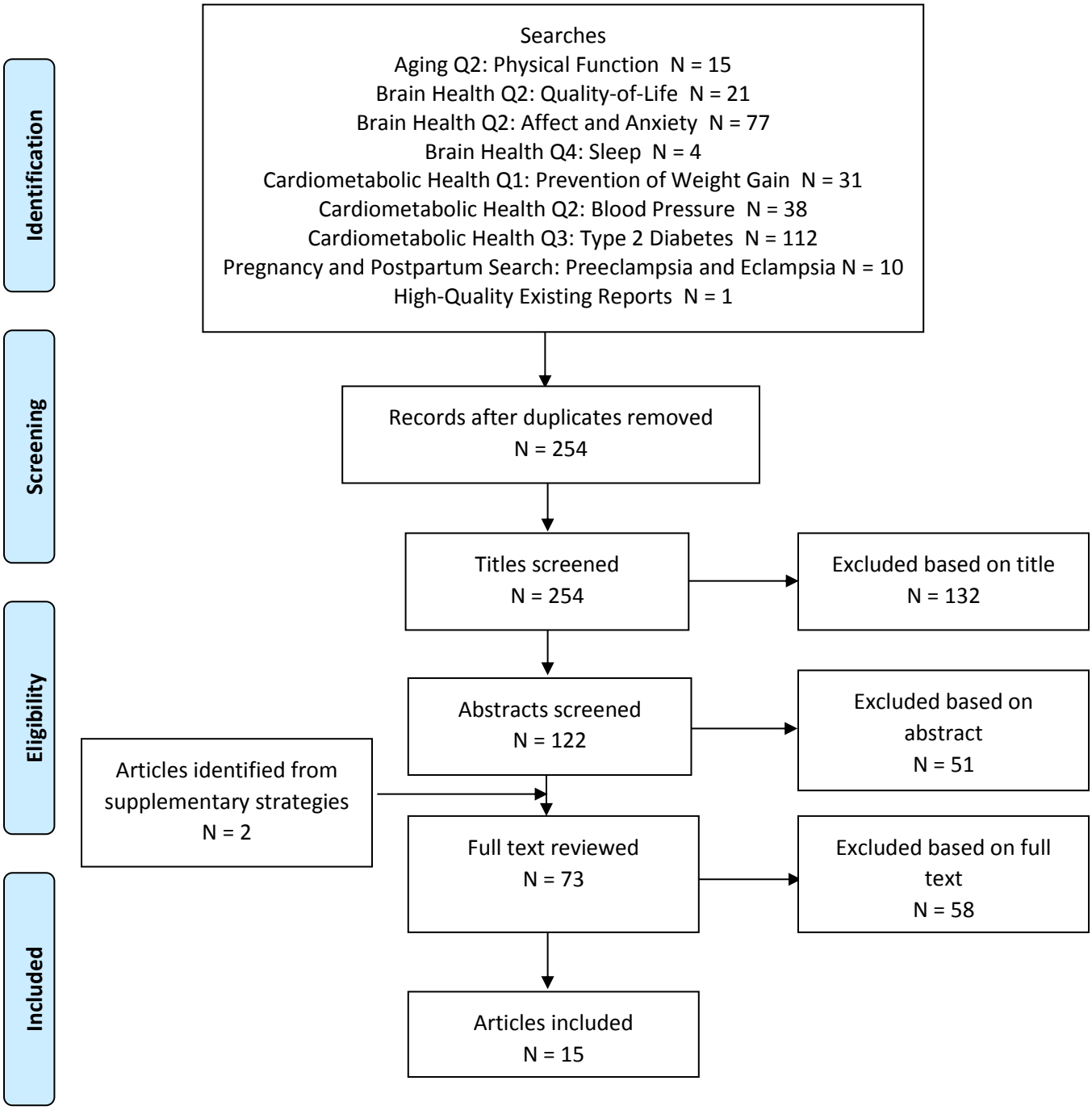
Set	Search Terms
Physical Activity	("Aerobic endurance" OR "Bicycl*" OR "Endurance training" OR "Exercise" OR "Exercises" OR "Free living activities" OR "Free living activity" OR "Functional training" OR "Leisure-time physical activity" OR "Lifestyle activities" OR "Lifestyle activity" OR "Muscle stretching exercises" OR "Physical activity" OR "Qi gong" OR "Recreational activities" OR "Recreational activity" OR "Resistance training" OR "Running" OR "Sedentary lifestyle" OR "Speed training" OR "Strength training" OR "Tai chi" OR "Tai ji" OR "Tai ji" OR "Training duration" OR "Training frequency" OR "Training intensity" OR "Treadmill" OR "Walking" OR "Weight lifting" OR "Weight training" OR "Yoga" OR "Aerobic activities" OR "Aerobic activity" OR "Cardiovascular activities" OR "Cardiovascular activity" OR "Endurance activities" OR "Endurance activity" OR "Physical activities" OR "Physical conditioning" OR "Sedentary")
Outcomes	("eclampsia" OR "pre-eclampsia" OR "preeclampsia")
Limits	2006-present Cochrane Reviews and Other Reviews Word variations will not be searched

Supplementary Strategies

At full text review members of the Physical Activity Guidelines Pregnancy and Postpartum Work Group identified two relevant articles for consideration[16, 17] that were not captured by the search strategies.

Appendix C: Literature Tree

Existing Systematic Reviews, Meta-Analyses, Pooled Analyses, and Reports Literature Tree



Appendix D: Inclusion/Exclusion Criteria

Pregnancy and Postpartum Work Group
What is the relationship between physical activity and the incidence of gestational diabetes mellitus?

a. What dose of physical activity is associated with the reported quantitative benefit or risk?
b. Is there a dose-response relationship? If yes, what is the shape of the relationship?
c. Does the relationship vary by age, race/ethnicity, socio-economic status, or weight status?

Category	Inclusion/Exclusion Criteria	Notes/Rationale
Publication Language	**Include:** • Studies published with full text in English	
Publication Status	**Include:** • Studies published in peer-reviewed journals • Reports determined to have appropriate suitability and quality by PAGAC **Exclude:** • Grey literature, including unpublished data, manuscripts, abstracts, conference proceedings	
Research Type	**Include:** • Original research • Meta-analyses • Systematic reviews • Pooled analyses • Reports determined to have appropriate suitability and quality by PAGAC	
Study Subjects	**Include:** • Human subjects	
	• Pregnant adolescents and women • Postpartum adolescents and women	
Age of Study Subjects	**Include:** • Pregnant or postpartum adolescents and women: All ages	
Health Status of Study Subjects	**Exclude:** • Studies that specifically include people because of their disease state (e.g., cancer, chronic disease, diabetes, cardiovascular disease) • Participants hospitalized for reasons other than birth/delivery only (acute care, admitted into the hospital, rehabilitation facilities) • Nonambulatory adults only	
Comparison	**Include:**	

	• Pregnant women and postpartum mothers who participate in varying levels of physical activity, including no reported physical activity	
Date of Publication	**Include:** • Original research published 2006 to present • Systematic reviews and meta-analyses published from 2006 to present	
Study Design	**Include:** • Randomized controlled trials • Non-randomized controlled trials • Prospective cohort studies • Retrospective cohort studies • Case-control studies • Systematic reviews • Meta-analyses • Pooled reports • PAGAC-approved reports **Exclude:** • Cross-sectional studies • Before-and-after studies • Narrative reviews • Commentaries • Editorials	
Exposure/ Intervention	**Include studies in which the exposure or intervention is:** • All types and intensities of physical activity, including lifestyle activities, leisure activities, and sedentary behavior **Exclude:** • Studies missing physical activity (mental games such as Sudoku instead of physical activities) • Studies of a single, acute session of exercise • Studies of a disease-specific therapeutic exercise delivered by a medical professional (e.g., physical therapist) • Studies with measures of physical fitness as the exposure • Studies of multimodal interventions that do not present data on physical activity alone • Studies that only use physical activity as a confounding variable	
Outcome	**Include studies in which the outcome is:** • Gestational diabetes mellitus	

Appendix E: Rationale for Exclusion at Abstract or Full-Text Triage for Existing Systematic Reviews, Meta-Analyses, Pooled Analyses, and Reports

The table below lists the excluded articles with at least one reason for exclusion, but may not reflect all possible reasons.

Citation	Outcome	Population	Study Design	Exposure	Not ideal fit for replacement of de novo search	Other
Allen R, Rogozinska E, Sivarajasingam P, Khan KS, Thangaratinam S. Effect of diet- and lifestyle-based metabolic risk-modifying interventions on preeclampsia: a meta-analysis. *Acta Obstet Gynecol Scand.* 2014;93(10):973-985. doi:10.1111/aogs.12467.				X		
Amorim Adegboye AR, Linne YM. Diet or exercise, or both, for weight reduction in women after childbirth. *Cochrane Database Syst Rev*. 2013;(7):CD005627. doi:10.1002/14651858.CD005627.pub3.	X					
Amorim AR, Linne YM, Lourenco PM. Diet or exercise, or both, for weight reduction in women after childbirth. *Cochrane Database Syst Rev*. 2007;(3):Cd005627. doi:10.1002/14651858.CD005627.pub2.						X
Aune, D, Saugstad, OD, Henriksen, T, et al. Physical activity and the risk of preeclampsia: a systematic review and meta-analysis. Epidemiology. 2014. 25(3):331-43.	X					
Bain E, Crane M, Tieu J, et al. Diet and exercise interventions for preventing gestational diabetes mellitus. *Cochrane Database Syst Rev.* 2015;(4):Cd010443. doi:10.1002/14651858.CD010443.pub2.				X		
Beddoe AE, Lee KA. Mind-body interventions during pregnancy. *J Obstet Gynecol Neonatal Nurs*. 2008;37(2):165-175. doi:10.1111/j.1552-6909.2008.00218.x.				X		
Berger AA, Peragallo-Urrutia R, Nicholson WK. Systematic review of the effect of individual and combined nutrition and exercise interventions on weight, adiposity and metabolic outcomes after delivery: evidence for developing behavioral guidelines for post-partum weight control. *BMC Pregnancy Childbirth.* 2014;14:319. doi:10.1186/1471-2393-14-319.	X					
Bgeginski R, Ribeiro PA, Mottola MF, Ramos JG. Effects of weekly supervised exercise or physical activity counseling on fasting blood glucose in women diagnosed with gestational diabetes mellitus: a systematic review and meta-		X				

Citation	Outcome	Population	Study Design	Exposure	Not ideal fit for replacement of de novo search	Other
analysis of randomized trials. *J Diabetes*. Dec 2016. doi:10.1111/1753-0407.12519.						
Bo K, Artal R, Barakat R, et al. Exercise and pregnancy in recreational and elite athletes: 2016 evidence summary from the IOC expert group meeting, Lausanne. Part 1-exercise in women planning pregnancy and those who are pregnant. *Br J Sports Med*. 2016;50(10):571-589. doi:10.1136/bjsports-2016-096218.			X			
Bonzini M, Coggon D, Palmer KT. Risk of prematurity, low birthweight and pre-eclampsia in relation to working hours and physical activities: a systematic review. *Occup Environ Med*. 2007;64(4):228–243. doi:10.1136/oem.2006.026872.	X					
Brown J, Alwan NA, West J, et al. Lifestyle interventions for the treatment of women with gestational diabetes. *Cochrane Database Syst Rev*. 2017;5:Cd011970. doi:10.1002/14651858.CD011970.pub2.				X		
Busanich BM, Verscheure SD. Does McKenzie therapy improve outcomes for back pain? *J Athl Train*. 2006;41(1):117-119.		X				
Cameron AJ, Spence AC, Laws R, Hesketh KD, Lioret S, Campbell KJ. A review of the relationship between socioeconomic position and the early-life predictors of obesity. *Curr Obes Rep*. 2015;4(3):350-362. doi:10.1007/s13679-015-0168-5.	X					
Carolan-OIah MC. Educational and intervention programmes for gestational diabetes mellitus (GDM) management: an integrative review. *Collegian*. 2016;23(1):103-114.				X		
Choi J, Fukuoka Y, Lee JH. The effects of physical activity and physical activity plus diet interventions on body weight in overweight or obese women who are pregnant or in postpartum: a systematic review and meta-analysis of randomized controlled trials. *Prev Med*. 2013;56(6):351-364. doi:10.1016/j.ypmed.2013.02.021.				X		
Cooney GM, Dwan K, Greig CA, et al. Exercise for depression. *Cochrane Database Syst Rev.* 2013;(9):Cd004366. doi:10.1002/14651858.CD004366.pub6.		X				

Citation	Outcome	Population	Study Design	Exposure	Not ideal fit for replacement of de novo search	Other
Cooper D, Yang L. *Pregnancy, Exercise*. Treasure Island, FL: StatPearls Publishing; 2017.			X			
Craig M, Howard L. Postnatal depression. *BMJ Clin Evid*. Jan 2009:pii:1407.		X				
Curtis K, Weinrib A, Katz J. Systematic review of yoga for pregnant women: current status and future directions. *Evid Based Complement Alternat Med*. 2012;2012:715942. doi:10.1155/2012/715942.	X					
Daley A. Exercise and depression: a review of reviews. *J Clin Psychol Med Settings.* 2008;15(2):140–147. doi:10.1007/s10880-008-9105-z.			X			
Daley AJ, Foster L, Long G, et al. The effectiveness of exercise for the prevention and treatment of antenatal depression: systematic review with meta-analysis. *BJOG*. 2015;122(1):57-62. doi:10.1111/1471-0528.12909.					X	
Daley A, Jolly K, MacArthur C. The effectiveness of exercise in the management of post-natal depression: systematic review and meta-analysis. *Fam Pract.* 2009;26(2):154–162. doi:10.1093/fampra/cmn101.		X				
Daley AJ, Jolly K, Sharp DJ, et al. The effectiveness of exercise as a treatment for postnatal depression: study protocol. *BMC Pregnancy Childbirth*. 2012;12:45. doi:10.1186/1471-2393-12-45.			X			
Davies GA, Maxwell C, McLeod L, et al. Obesity in pregnancy. *J Obstet Gynaecol Can*. 2010;32(2):165-173. doi:10.1016/S1701-2163(16)34432-2.				X		
Delissaint D, McKyer EL. A systematic review of factors utilized in preconception health behavior research. *Health Educ Behav*. 2011;38(6):603-616. doi:10.1177/1090198110389709.				X		
Dietz P, Watson ED, Sattler MC, Ruf W, Titze S, van Poppel M. The influence of physical activity during pregnancy on maternal, fetal or infant heart rate variability: a systematic review. *BMC Pregnancy Childbirth*. 2016;16(1):326. doi:10.1186/s12884-016-1121-7.	X					
Dodd JM, Grivell RM, Crowther CA, Robinson JS. Antenatal interventions for overweight or obese pregnant women: a systematic review of randomised trials. *BJOG*. 2010;117(11):1316-1326. doi:10.1111/j.1471-0528.2010.02540.x.				X		

Citation	Outcome	Population	Study Design	Exposure	Not ideal fit for replacement of de novo search	Other
Elliott-Sale KJ, Barnett CT, Sale C. Systematic review of randomised controlled trials on exercise interventions for weight management during pregnancy and up to one year postpartum among normal weight, overweight and obese women. *Pregnancy Hypertens*. 2014;4(3):234. doi:10.1016/j.preghy.2014.03.015.	X					
Facchinetti F, Dante G, Petrella E, Neri I. Dietary interventions, lifestyle changes, and dietary supplements in preventing gestational diabetes mellitus: a literature review. *Obstet Gynecol Surv*. 2014;69(11):669–680. doi:10.1097/OGX.0000000000000121.				X		
Fasanmade OA, Dagogo-Jack S. Diabetes care in Nigeria. *Ann Glob Health.* 2015;81(6):821–829. doi:10.1016/j.aogh.2015.12.012.	X					
Fazzi C, Saunders DH, Linton K, Norman JE, Reynolds RM. Sedentary behaviours during pregnancy: a systematic review. *Int J Behav Nutr Phys Act*. 2017;14(1):32. doi:10.1186/s12966-017-0485-z.						X
Ferraro ZM, Gaudet L, Adamo KB. The potential impact of physical activity during pregnancy on maternal and neonatal outcomes. *Obstet Gynecol Surv.* 2012;67(2):99-110. doi:10.1097/OGX.0b013e318242030e.			X			
Field T. Prenatal depression risk factors, developmental effects and interventions: a review. *J Pregnancy Child Health.* 2017;4(1). doi:10.4172/2376-127X.1000301.			X			
Firth A, Haith-Cooper M, Egan D. Do psychosocial interventions have an impact on maternal perception of perinatal depression? *Br J Midwifery*. 2016;24(12):855–866. doi:10.12968/bjom.2016.24.12.855.	X					
Foster NE, Bishop A, Bartlam B, et al. Evaluating Acupuncture and Standard carE for pregnant women with back pain (EASE Back): a feasibility study and pilot randomised trial. *Health Technol Assess*. 2016;20(33):1-236. doi:10.3310/hta20330.			X			
Gardner B, Wardle J, Poston L, Croker H. Changing diet and physical activity to reduce gestational weight gain: a meta-analysis. *Obes Rev.* 2011;12(7):e602-				X		

Citation	Outcome	Population	Study Design	Exposure	Not ideal fit for replacement of de novo search	Other
e620. doi:10.1111/j.1467-789X.2011.00884.x.						
Gavard JA, Artal R. Effect of exercise on pregnancy outcome. *Clin Obstet Gynecol.* 2008;51(2):467-480. doi:10.1097/GRF.0b013e31816feb1d.						X
Gilinsky AS, Kirk AF, Hughes AR, Lindsay RS. Lifestyle interventions for type 2 diabetes prevention in women with prior gestational diabetes: A systematic review and meta-analysis of behavioural, anthropometric and metabolic outcomes. *Prev Med Rep*. 2015;2:448-461. doi:10.1016/j.pmedr.2015.05.009.		X				
Gindlesberger D, Schrager S, Johnson S, Neher JO. Clinical inquiries. What's the best treatment for gestational diabetes? *J Fam Pract*. 2007;56(9):757-758.		X				
Gong H, Ni C, Shen X, Wu T, Jiang C. Yoga for prenatal depression: a systematic review and meta-analysis. *BMC Psychiatry*. 2015;15:14. doi:10.1186/s12888-015-0393-1.		X				
Harrison AL, Shields N, Taylor NF, Frawley HC. Exercise improves glycaemic control in women diagnosed with gestational diabetes mellitus: a systematic review. *J Physiother*. 2016;62(4):188-196. doi:10.1016/j.jphys.2016.08.003.		X				
Hollenbach D, Broker R, Herlehy S, Stuber K. Non-pharmacological interventions for sleep quality and insomnia during pregnancy: a systematic review. *J Can Chiropr Assoc*. 2013;57(3):260-270.					X	
Jacqueminet S, Jannot-Lamotte MF. Therapeutic management of gestational diabetes. *Diabetes Metab*. 2010;36(6 Pt 2):658-671. doi:10.1016/j.diabet.2010.11.016.		X				
Johnson M, Campbell F, Messina J, Preston L, Buckley Woods H, Goyder E. Weight management during pregnancy: a systematic review of qualitative evidence. *Midwifery.* 2013;29(12):1287-1296. doi:10.1016/j.midw.2012.11.016.			X			
Jones L, Othman M, Dowswell T, et al. Pain management for women in labour: an overview of systematic reviews. *Cochrane Database Syst Rev.* 2012;(3):CD009234. doi:10.1002/14651858.CD009234.pub2.	X					

Citation	Outcome	Population	Study Design	Exposure	Not ideal fit for replacement of de novo search	Other
Kasawara KT, do Nascimento SL, Costa ML, Surita FG, e Silva JL. Exercise and physical activity in the prevention of pre-eclampsia: systematic review. *Acta Obstet Gynecol Scand*. 2012;91(10):1147–1157. doi:10.1111/j.1600-0412.2012.01483.x.	X					
Kinser PA, Pauli J, Jallo N, et al. Physical activity and yoga-based approaches for pregnancy-related low back and pelvic pain. *J Obstet Gynecol Neonatal Nurs*. 2017;46(3):334-346. doi:10.1016/j.jogn.2016.12.006.			X			
Kuhlmann AK, Dietz PM, Galavotti C, England LJ. Weight-management interventions for pregnant or postpartum women. *Am J Prev Med*. 2008;34(6):523-528. doi:10.1016/j.amepre.2008.02.010.				X		
Lamina S, Agbanusi E. Effect of aerobic exercise training on maternal weight gain in pregnancy: a meta-analysis of randomized controlled trials. *Ethiop J Health Sci.* 2013;23(1):59-64.						X
Lawrence A, Lewis L, Hofmeyr GJ, Styles C. Maternal positions and mobility during first stage labour. *Cochrane Database Syst Rev*. 2013;(10):CD003934. doi:10.1002/14651858.CD003934.pub4.				X		
Lawrence A, Lewis L, Hofmeyr GJ, Dowswell T, Styles C. Maternal positions and mobility during first stage labour. *Cochrane Database Syst Rev*. 2009;(2):Cd003934. doi:10.1002/14651858.CD003934.pub2.				X		
Liddle SD, Pennick V. Interventions for preventing and treating low-back and pelvic pain during pregnancy. *Cochrane Database Syst Rev*. 2015;(9):Cd001139. doi:10.1002/14651858.CD001139.pub4.	X					
Magro-Malosso ER, Saccone G, Di Mascio D, Di Tommaso M, Berghella V. Exercise during pregnancy and risk of preterm birth in overweight and obese women: a systematic review and meta-analysis of randomized controlled trials. *Acta Obstet Gynecol Scand*. 2017;96(3):263–273. doi:10.1111/aogs.13087.						X
Manna P, Jain SK. Obesity, oxidative stress, adipose tissue dysfunction, and the associated health risks: causes and therapeutic strategies. *Metab Syndr*	X					

Citation	Outcome	Population	Study Design	Exposure	Not ideal fit for replacement of de novo search	Other
Relat Disord. 2015;13(10):423-444. doi:10.1089/met.2015.0095.						
Marc I, Toureche N, Ernst E, et al. Mind-body interventions during pregnancy for preventing or treating women's anxiety. *Cochrane Database Syst Rev*. 2011;(7):Cd007559. doi:10.1002/14651858.CD007559.pub2.						X
Mathias PC, Elmhiri G, de Oliveira JC, et al. Maternal diet, bioactive molecules, and exercising as reprogramming tools of metabolic programming. *Eur J Nutr*. 2014;53(3):711-722. doi:10.1007/s00394-014-0654-7.			X			
McCurdy AP, Boule NG, Sivak A, Davenport MH. Effects of exercise on mild-to-moderate depressive symptoms in the postpartum period: a meta-analysis. *Obstet Gynecol*. 2017;129(6):1087–1097. doi:10.1097/AOG.0000000000002053.	X					
McDonald SM, Liu J, Wilcox S, Lau EY, Archer E. Does dose matter in reducing gestational weight gain in exercise interventions? A systematic review of literature. *J Sci Med Sport*. 2016;19(4):323–335. doi:10.1016/j.jsams.2015.03.004.	X					
Mead GE, Morley W, Campbell P, Greig CA, McMurdo M, Lawlor DA. Exercise for depression. *Cochrane Database Syst Rev.* 2008;(4):CD004366. doi:10.1002/14651858.CD004366.pub3.		X				
Meher S, Duley L. Exercise or other physical activity for preventing pre-eclampsia and its complications. *Cochrane Database Syst Rev*. April 2006;(2):Cd005942. doi:10.1002/14651858.CD005942.					X	
Meher S, Duley L. Rest during pregnancy for preventing pre-eclampsia and its complications in women with normal blood pressure. *Cochrane Database Syst Rev*. 2006;(2):Cd005939. doi:10.1002/14651858.CD005939.					X	
Misra A, Khurana L. Obesity and the metabolic syndrome in developing countries. *J Clin Endocrinol Metab.* 2008;93(11)(suppl 1):S9–S30. doi:10.1210/jc.2008-1595.		X				
Moran LJ, Hutchison SK, Norman RJ, Teede HJ. Lifestyle changes in women with polycystic ovary syndrome. *Cochrane Database of Systematic*		X				

Citation	Outcome	Population	Study Design	Exposure	Not ideal fit for replacement of de novo search	Other
Reviews. 2011;(2):CD007506. doi:10.1002/14651858.CD007506.pub2.						
Morkved S, Bo K. Effect of pelvic floor muscle training during pregnancy and after childbirth on prevention and treatment of urinary incontinence: a systematic review. *Br J Sports Med*. 2014;48(4):299-310. doi:10.1136/bjsports-2012-091758.	X					
Muktabhant B, Lawrie TA, Lumbiganon P, Laopaiboon M. Diet or exercise, or both, for preventing excessive weight gain in pregnancy. *Cochrane Database Syst Rev*. 2015;(6):Cd007145. doi:10.1002/14651858.CD007145.pub3.	X					
Nascimento SL, Pudwell J, Surita FG, Adamo KB, Smith GN. The effect of physical exercise strategies on weight loss in postpartum women: a systematic review and meta-analysis. *Int J Obes (Lond)*. 2014;38(5):626–635. doi:10.1038/ijo.2013.183.	X					
Nascimento SL, Surita FG, Parpinelli MA, Cecatti JG. Physical exercise, weight gain, and perinatal outcomes in overweight and obese pregnant women: a systematic review of clinical trials. *Cad Saude Publica.* 2011;27(3):407-416.						X
Nascimento SL, Surita FG, Cecatti JG. Physical exercise during pregnancy: a systematic review. *Curr Opin Obstet Gynecol*. 2012;24(6):387-394. doi:10.1097/GCO.0b013e328359f131.						X
Nasiri-Amiri F, Bakhtiari A, Faramarzi M, Adib Rad H, Pasha H. The association between physical activity during pregnancy and gestational diabetes mellitus: a case-control study. *Int J Endocrinol Metab.* 2016;14(3):e37123. doi:10.5812/ijem.37123.			X			
O'Brien OA, McCarthy M, Gibney ER, McAuliffe FM. Technology-supported dietary and lifestyle interventions in healthy pregnant women: a systematic review. *Eur J Clin Nutr*. 2014;68(7):760-766. doi:10.1038/ejcn.2014.59.				X		
Osman SM, Saaka M, Siassi F, et al. A comparison of pregnancy outcomes in Ghanaian women with varying dietary diversity: a prospective cohort study protocol. *BMJ Open*. 2016;6(9):e011498. doi:10.1136/bmjopen-2016-011498.			X			
Oteng-Ntim E, Varma R, Croker H, Poston L, Doyle P. Lifestyle interventions				X		

Citation	Outcome	Population	Study Design	Exposure	Not ideal fit for replacement of de novo search	Other
for overweight and obese pregnant women to improve pregnancy outcome: systematic review and meta-analysis. *BMC Med*. 2012;10:47. doi:10.1186/1741-7015-10-47.						
Pennick V, Liddle SD. Interventions for preventing and treating pelvic and back pain in pregnancy. *Cochrane Database Syst Rev.* 2013;(8):Cd001139. doi:10.1002/14651858.CD001139.pub3.						X
Pennick VE, Young G. Interventions for preventing and treating pelvic and back pain in pregnancy. *Cochrane Database Syst Rev.* 2007;(2):Cd001139. doi:10.1002/14651858.CD001139.pub2.	X					
Peppers D, Figoni SF, Carroll BW, Chen MM, Song S, Mathiyakom W. Influence of functional capacity evaluation on physician's assessment of physical capacity of veterans with chronic pain: a retrospective analysis. *PM R*. 2016;9(7):652-659. doi:10.1016/j.pmrj.2016.10.011.			X			
Pivarnik JM, Chambliss HO, Clapp JF, et al. Impact of physical activity during pregnancy and postpartum on chronic disease risk. *Med Sci Sports Exerc.* 2006;38(5):989-1006. doi:10.1249/01.mss.0000218147.51025.8a.			X			
Poyatos-León R, García-Hermoso A, Sanabria-Martínez G, Álvarez-Bueno C, Cavero-Redondo I, Martínez-Vizcaíno V. Effects of exercise-based interventions on postpartum depression: a meta-analysis of randomized controlled trials. *Birth*. 2017;44(3):200–208. doi:10.1111/birt.12294.	X					
Regan M. 'Yoga for prenatal depression: a systematic review and meta-analysis.' Gong H et al (2015). BMC Psychiatry 15(1):14. *The Practising Midwife*. 2015;18(5):38–41.			X			
Richards E, van Kessel G, Virgara R, Harris P. Does antenatal physical therapy for pregnant women with low back pain or pelvic pain improve functional outcomes? A systematic review. *Acta Obstet Gynecol Scand*. 2012;91(9):1038-1045. doi:10.1111/j.1600-0412.2012.01462.x.	X					
Rimer J, Dwan K, Lawlor DA, et al. Exercise for depression. *Cochrane*		X				

Citation	Outcome	Population	Study Design	Exposure	Not ideal fit for replacement of de novo search	Other
Database Syst Rev. 2012;(7):Cd004366. doi:10.1002/14651858.CD004366.pub5.						
Rogozinska E, Fen Y, Molyneaux E, Khan KS, Thangaratinam S. Variation in outcomes in trials reporting effects of diet and lifestyle based intervention on pregnancy outcomes: a systematic review. *Pregnancy Hypertens*. 2014;4(3):237. doi:10.1016/j.preghy.2014.03.024.			X			
Rogozińska E, Marlin N, Yang F, et al; i-WIP (International Weight Management in Pregnancy) Collaborative Group. Variations in reporting of outcomes in randomized trials on diet and physical activity in pregnancy: a systematic review. *J Obstet Gynaecol Res*. 2017;43(7):1101–1110. doi:10.1111/jog.13338.	X					
Ronnberg AK, Nilsson K. Interventions during pregnancy to reduce excessive gestational weight gain: a systematic review assessing current clinical evidence using the Grading of Recommendations, Assessment, Development and Evaluation (GRADE) system. *BJOG*. 2010;117(11):1327-1334. doi:10.1111/j.1471-0528.2010.02619.x.				X		
Ruifrok AE, Rogozinska E, van Poppel MN, et al. Study protocol: differential effects of diet and physical activity based interventions in pregnancy on maternal and fetal outcomes–individual patient data (IPD) meta-analysis and health economic evaluation. *Syst Rev*. 2014;3:131. doi:10.1186/2046-4053-3-131.			X			
Rungsiprakarn P, Laopaiboon M, Sangkomkamhang US, Lumbiganon P, Pratt JJ. Interventions for treating constipation in pregnancy. *Cochrane Database Syst Rev*. 2015;(9):Cd011448. doi:10.1002/14651858.CD011448.pub2.				X		
Saligheh M, Hackett D, Boyce P, Cobley S. Can exercise or physical activity help improve postnatal depression and weight loss? A systematic review. *Arch Womens Ment Health*. July 2017. doi:10.1007/s00737-017-0750-9.				X		
Sheffield KM, Woods-Giscombe CL. Efficacy, feasibility, and acceptability of perinatal yoga on women's mental health and well-being: a systematic literature review. *J Holist Nurs*.	X					

Citation	Outcome	Population	Study Design	Exposure	Not ideal fit for replacement of de novo search	Other
2016;34(1):64–79. doi:10.1177/0898010115577976.						
Shivakumar G, Brandon AR, Snell PG, et al. Antenatal depression: a rationale for studying exercise. *Depress Anxiety*. 2011;28(3):234–242. doi:10.1002/da.20777.	X					
Shi Z, MacBeth A. The effectiveness of mindfulness-based interventions on maternal perinatal mental health outcomes: a systematic review. *Mindfulness (NY).* 2017;8(4):823–847. doi:10.1007/s12671-016-0673-y.	X					
Skouteris H, Morris H, Nagle C, Nankervis A. Behavior modification techniques used to prevent gestational diabetes: a systematic review of the literature. *Curr Diab Rep.* 2014;14(4):480. doi:10.1007/s11892-014-0480-6.				X		
Snapp CA, Donaldson SK. Gestational diabetes mellitus: physical exercise and health outcomes. *Biol Res Nurs*. 2008;10(2):145-155. doi:10.1177/1099800408323728.			X			
Spencer L, Rollo M, Hauck Y, et al. The effect of weight management interventions that include a diet component on weight-related outcomes in pregnant and postpartum women: a systematic review protocol. *JBI Database System Rev* Implement Rep. 2015;13(1):88-98. doi:10.11124/jbisrir-2015-1812.			X			
Steiner RD, Adsit J, Basel D. COL1A1/2-Related Osteogenesis Imperfecta. In: *GeneReviews.* Seattle (WA): University of Washington, Seattle; 1993-2017.		X				
Streuling I, Beyerlein A, Rosenfeld E, Hofmann H, Schulz T, von Kries R. Physical activity and gestational weight gain: a meta-analysis of intervention trials. *BJOG.* 2011;118(3):278–284. doi:10.1111/j.1471-0528.2010.02801.x.	X					
Streuling I, Beyerlein A, von Kries R. Can gestational weight gain be modified by increasing physical activity and diet counseling? A meta-analysis of interventional trials. *Am J Clin Nutr*. 2010;92(4):678-687. doi:10.3945/ajcn.2010.29363.				X		
Sui Z, Grivell RM, Dodd JM. Antenatal exercise to improve outcomes in overweight or obese women: a systematic review. *Acta Obstet Gynecol*	X					

Citation	Outcome	Population	Study Design	Exposure	Not ideal fit for replacement of de novo search	Other
Scand. 2012;91(5):538–545. doi:10.1111/j.1600-0412.2012.01357.x.						
Taylor BJ, Heath AL, Galland BC, et al. Prevention of Overweight in Infancy (POI.nz) study: a randomised controlled trial of sleep, food and activity interventions for preventing overweight from birth. *BMC Public Health*. 2011;11:942. doi:10.1186/1471-2458-11-942.			X			
Teychenne M, York R. Physical activity, sedentary behavior, and postnatal depressive symptoms: a review. *Am J Prev Med*. 2013;45(2):217–227. doi:10.1016/j.amepre.2013.04.004.	X					
Thangaratinam S, Rogozinska E, Jolly K, et al. Effects of interventions in pregnancy on maternal weight and obstetric outcomes: meta-analysis of randomised evidence. *BMJ*. 2012;(344):e2088. doi:10.1136/bmj.e2088.	X					
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Turawa EB, Musekiwa A, Rohwer AC. Interventions for preventing postpartum constipation. *Cochrane Database Syst Rev*. 2015;(9):CD011625. doi:10.1002/14651858.CD011625.pub2.				X		
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Citation	Outcome	Population	Study Design	Exposure	Not ideal fit for replacement of de novo search	Other
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