Evidence Portfolio – Pregnancy and Postpartum Work Group, Question 3

What is the relationship between physical activity and the incidence of preeclampsia and eclampsia?

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 Reviews and Meta-Analyses

Conclusion Statements and Grades

Limited evidence suggests that leisure-time physical activity or exercise training lowers the risk of preeclampsia. **PAGAC Grade: Limited**

Limited evidence suggests that a dose of physical activity similar to the 2015 American College of Obstetricians and Gynecologists Guidelines and the 2008 Physical Activity Guidelines is associated with a lower risk of preeclampsia. **PAGAC Grade: Limited.** Limited evidence suggests that a dose-response relationship exists between physical activity and the incidence of preeclampsia. **PAGAC Grade: Limited**.

Insufficient evidence is available to determine whether the relationship between physical activity and preeclampsia 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 Reviews and Meta-Analyses

Overview

A total of 9 existing reviews that examined the association between physical activity and the incidence of preeclampsia and eclampsia were included: 7 meta-analyses[1-7] and 2 systematic reviews.[8, 9] The reviews were published between 2011 and 2017.

The meta-analyses included a range of 5 to 81 studies and covered the following timeframe: inception to 2012[1]; 1966 to 2005[2]; inception to 2015[3]; inception to 2011[5]; inception to 2016[4, 7]; and inception to 2014.[6]

The systematic reviews included a range of 11 to 26 studies and covered the following timeframes: from inception to 2011 (Wolf, et al., 2014). One systematic review[8] did not report a timeframe.

Exposures

The included reviews examined different types of physical activity performed before and during pregnancy, including walking and different intensities of physical activity[1]; occupational physical activity, including lifting and heavy physical workload[2]; leisure-time physical activity[3, 9]; and aerobic exercise.[4] One review examined sedentary behaviors.[8]

Outcomes

All reviews examined risk or incidence of preeclampsia. One review also assessed risk of eclampsia.[6]

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	Other
Aune, 2014		Female			Pregnant	Smoking status; Geographic location: Europe, America, Asia
Bonzini, 2007	Female				Pregnant, Postpartum	
da Silva, 2017	Female				Pregnant	
Di Mascio, 2016		Female		Normal/Healthy Weight (BMI: 18.5–24.9)	Pregnant	
Fazzi, 2017	Female		>16		Pregnant	
Kasawara, 2012		Female	Adults		Pregnant	
Muktabhant, 2015	Female			Normal/Healthy Weight (BMI: 18.5–24.9), Overweight and Obese	Pregnant, Postpartum	
Wolf, 2014		Female			Pregnant	
Zheng, 2017		Female			Pregnant	

Supporting Evidence

Existing Systematic Reviews and Meta-Analyses

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

<table>
<tr><td colspan="2">Meta-Analysis
Citation: Aune D, Saugstad OD, Henriksen T, Tonstad S. Physical activity and the risk of preeclampsia: a systematic review and meta-analysis. Epidemiology. 2014;25(3):331-343. doi:10.1097/EDE.0000000000000036.</td></tr>
<tr><td>Purpose: To systematically review and meta-analyze the dose-response relationship between PA and preeclampsia.</td><td rowspan="4">Abstract: BACKGROUND: Physical activity has been hypothesized to reduce the risk of preeclampsia, but epidemiologic studies have not shown consistent results. Therefore, we conducted a systematic review and dose-response meta-analysis of epidemiologic studies. METHODS: PubMed, Embase, and Ovid databases were searched for case-control and cohort studies of physical activity and preeclampsia up to 2 November 2012. We estimated summary relative risks (RRs) using a random effects model. RESULTS: Fifteen studies were included. The summary RR for high versus low prepregnancy physical activity was 0.65 (95% confidence interval [CI] = 0.47-0.89, I = 0%; n = 5). In the dose-response analysis, the summary RR was 0.72 (0.53-0.99; I = 0%; n = 3) per 1 hour per day and 0.78 (0.63-0.96; I = 0%; n = 2) per 20 metabolic equivalent task (MET)-hours per week. The summary RR for high versus low physical activity in early pregnancy was 0.79 (0.70-0.91; I = 0%; n = 11). In the dose-response analysis, the summary RR per 1 hour per day was 0.83 (0.72-0.95; I = 21%; n = 7) and 0.85 (0.68-1.07; I = 69%; n = 3) per 20 MET-hours per week. A nonlinear association was observed for physical activity before pregnancy and risk of preeclampsia (test for nonlinearity, P = 0.03), but not for physical activity in early pregnancy (test for nonlinearity, P = 0.37), with a flattening of the curve at higher levels of activity. Both walking and greater intensity of physical activity were inversely associated with preeclampsia. CONCLUSIONS: Our analysis suggests a reduced risk of preeclampsia with increasing levels of physical activity before pregnancy and during early pregnancy.</td></tr>
<tr><td>Timeframe: Inception–November 2012</td></tr>
<tr><td>Total # of Studies: 15</td></tr>
<tr><td>Exposure Definition: Level of PA; dose-response per 20 metabolic equivalent (MET) hours/week; or per 1 hour of PA per day; intensity of PA (high intensity vs low intensity); specific types of PA (high vs low walking; high vs low occupational PA; and high vs low leisure-time PA).
Measures Steps: No
Measures Bouts: No
Examines HIIT: No</td></tr>
<tr><td>Outcomes Addressed: Risk of preeclampsia.
Examine Cardiorespiratory Fitness as Outcome: No</td></tr>
<tr><td>Populations Analyzed: Female; Pregnant; Smoking status; Geographic location: Europe, America, Asia.</td><td>Author-Stated Funding Source: Norwegian SIDS and Stillbirth Society (Landsforeningen Uventet Barnedød).</td></tr>
</table>

Meta-Analysis **Citation:** 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.	
Purpose: To assess the evidence relating three major adverse outcomes (preterm delivery, low birthweight (LBW) and pre-eclampsia/gestational hypertension) to five common occupational exposures (prolonged working hours, shift work, lifting, standing, and heavy physical workload).	**Abstract:** BACKGROUND: Occupational activities are suspected of having an adverse impact on outcomes of pregnancy. AIM: To assess the evidence relating three major adverse outcomes (preterm delivery, low birthweight (LBW) and pre-eclampsia/gestational hypertension) to five common occupational exposures (prolonged working hours, shift work, lifting, standing and heavy physical workload). METHODS: A systematic search of Medline and Embase (1966-December 2005) using combinations of keywords and medical subject heading terms was conducted. For each relevant paper, standard details were abstracted that were then used to summarise the design features of studies, to rate their methodological quality (completeness of reporting and potential for important bias or confounding) and to provide estimates of effect. For studies with similar definitions of exposure and outcome, pooled estimates of relative risk (RR) in meta-analysis were calculated. RESULTS: 53 reports were identified-35 on preterm delivery, 34 on birth weight and 9 on pre-eclampsia or gestational hypertension. These included 21 cohort investigations. For pre-term delivery, extensive evidence relating to each of the exposures of interest was found. Findings were generally consistent and tended to rule out a more than moderate effect size (RR >1.4). The larger and most complete studies were less positive, and pooled estimates of risk pointed to only modest or null effects. For small-for-gestational age, the position was similar, but the evidence base was more limited. For pre-eclampsia and gestational hypertension, it was too small to allow firm conclusions. CONCLUSIONS: The balance of evidence is not sufficiently compelling to justify mandatory restrictions on any of the activities considered in this review. However, given some uncertainties in the evidence base and the apparent absence of important beneficial effects, it may be prudent to advise against long working hours, prolonged standing and heavy physical work, particularly late in pregnancy. Our review identifies several priorities for future investigation.
Timeframe: 1966–December 2005	
Total # of Studies: 53	
Exposure Definition: Occupational PA (e.g., standing, lifting, and physical workload) and other unspecified PA. Data on exposure were collected mostly through self-report (by mail, telephone, or interview), but in a minority of studies job title was used as a surrogate index of exposure. **Measures Steps:** No **Measures Bouts:** No **Examines HIIT:** No	
Outcomes Addressed: Pre-eclampsia **Examine Cardiorespiratory Fitness as Outcome:** No	
Populations Analyzed: Female, Pregnant, Postpartum	**Author-Stated Funding Source:** Not reported.

<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.

Systematic Review

Citation: 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.

Purpose: To determine the time spent in sedentary behaviors and the prevalence of sedentary behaviors among pregnant women, and whether sedentary behaviors are associated with pregnancy outcomes in mothers and offspring.

Timeframe: Not reported

Total # of Studies: 26

Exposure Definition: Sedentary behaviors assessed in a variety of ways, including objective measurement (e.g., accelerometer, pedometer), questionnaire, or self-reported diaries. Non-objective measures were mostly focused on behaviors such as TV viewing and sitting time.
Measures Steps: No
Measures Bouts: No
Examines HIIT: No

Outcomes Addressed: Maternal outcomes: gestational weight gain, hypertensive disorders, depression, metabolic outcomes, blood lipid levels. Infant outcomes: birth weight, macrosomia, abdominal circumference, gestational length, risk of preterm delivery.
Examine Cardiorespiratory Fitness as Outcome: No

Populations Analyzed: Females >16, Pregnant

Abstract: BACKGROUND: In the general population, at least 50% of time awake is spent in sedentary behaviours. Sedentary behaviours are activities that expend less energy than 1.5 metabolic equivalents, such as sitting. The amount of time spent in sedentary behaviours is a risk factor for diseases such as type 2 diabetes, cardiovascular disease, and death from all causes. Even individuals meeting physical activity guidelines are at a higher risk of premature death and adverse metabolic outcomes if they sit for extended intervals. The associations between sedentary behaviour with type 2 diabetes and with impaired glucose tolerance are stronger for women than for men. It is not known whether sedentary behaviour in pregnancy influences pregnancy outcomes, but if those negative outcomes observed in general adult population also occur in pregnancy, this could have implications for adverse outcomes for mothers and offspring. We aimed to determine the proportion of time spent in sedentary behaviours among pregnant women, and the association of sedentary behaviour with pregnancy outcomes in mothers and offspring. METHODS: Two researchers independently performed the literature search using 5 different electronic bibliographic databases. Studies were included if sedentary behaviours were assessed during pregnancy. Two reviewers independently assessed the articles for quality and bias, and extracted the relevant information. RESULTS: We identified 26 studies meeting the inclusion criteria. Pregnant women spent more than 50% of their time in sedentary behaviours. Increased time in sedentary behaviour was significantly associated with higher levels of C Reactive Protein and LDL Cholesterol, and a larger newborn abdominal circumference. Sedentary behaviours were significantly higher among women who delivered macrosomic infants. Discrepancies were found in associations of sedentary behaviour with gestational weight gain, hypertensive disorders, and birth weight. No consistent associations were found between sedentary behaviour and other variables such as gestational diabetes. There was considerable variability in study design and methods of assessing sedentary behaviour. CONCLUSIONS: Our review highlights the significant time spent in sedentary behaviour during pregnancy, and that sedentary behaviour may impact on pregnancy outcomes for both mother and child. The considerable heterogeneity in the literature suggests future studies should use robust methodology for quantifying sedentary behaviour.

Author-Stated Funding Source: National Commission for Scientific and Technological Research, Tommy's and the British Heart Foundation, the MRC Centre Grant.

<table>
<tr><td colspan="2">Meta-Analysis
Citation: 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.</td></tr>
<tr><td>Purpose: To evaluate the association between exercise and PA and the development of pre-eclampsia.
Timeframe: Inception–June 2011
Total # of Studies: 17
Exposure Definition: PA such as occupational, leisure, or recreational activities.
Measures Steps: No
Measures Bouts: No
Examines HIIT: No
Outcomes Addressed: Risk of pre-eclampsia
Examine Cardiorespiratory Fitness as Outcome: No</td><td>Abstract: Exercise and physical activity have been studied and suggested as a way to reduce or minimize the effects of pre-eclampsia. Our aim was to evaluate the association between exercise and/or physical activity and occurrence of pre-eclampsia. We conducted electronic searches without year of publication and language limitations. This was a systematic review designed according to PRISMA. Different databases accessed were as follows: PubMed(R); Latin-American and Caribbean Literature in Health Sciences (LILACS); Scientific Electronic Library On-line (SciELO); Physiotherapy Evidence Database (PEDro); and ISI web of Knowledge(SM) . The Medical Subject Headings (MeSH) were as follows: ("exercise" OR "motor activity" OR "physical activity") AND ("pre-eclampsia" OR "eclampsia" OR "hypertension, pregnancy-induced"). Inclusion criteria were studies conducted in adults who were engaged in some physical activity. The selection and methodological evaluation were carried out by two independent reviewers. Risk assessment was made by the odds ratio (OR) and incidence of pre-eclampsia in the population who performed physical activity/exercise. A total of 231 articles were found, 214 of which were excluded based on title and full-text, so that 17 remained. Comparison of six case-control studies showed that physical activity had a protective effect on the development of pre-eclampsia [OR 0.77, 95% confidence interval (CI) 0.64-0.91, p < 0.01]. The 10 prospective cohort studies showed no significant difference (OR 0.99, 95% CI 0.93-1.05, p= 0.81). The only randomized clinical trial showed a protective effect on the development of pre-eclampsia in the stretching group (OR 6.34, 95% CI 0.72-55.37, p= 0.09). This systematic review indicates a trend toward a protective effect of physical activity in the prevention of pre-eclampsia.</td></tr>
<tr><td>Populations Analyzed: Female, Adults, Pregnant</td><td>Author-Stated Funding Source: No funding source used.</td></tr>
</table>

Meta-Analysis

Citation: 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.

Purpose: To evaluate the effectiveness and safety of diet or exercise, or both, interventions for preventing excessive weight gain during pregnancy.

Timeframe: Inception–November 2014

Total # of Studies: 65 (49 only in MA)

Exposure Definition: Exercise (supervised or unsupervised) interventions only, or with diet, included any activity requiring physical effort, carried out to sustain or improve health and fitness. Interventions varied widely in intensity and modality to include supervised exercise, individualized exercise programs, dance classes, and provision of pedometers or treadmills.
Measures Steps: No
Measures Bouts: No
Examines HIIT: No

Outcomes Addressed: Mother outcomes: weight gain (excessive or

Abstract: BACKGROUND: This is an update of a Cochrane review first published in 2012, Issue 4. Excessive weight gain during pregnancy is associated with poor maternal and neonatal outcomes including gestational diabetes, hypertension, caesarean section, macrosomia, and stillbirth. Diet or exercise interventions, or both, may reduce excessive gestational weight gain (GWG) and associated poor outcomes; however, evidence from the original review was inconclusive. OBJECTIVES: To evaluate the effectiveness of diet or exercise, or both, interventions for preventing excessive weight gain during pregnancy and associated pregnancy complications. SEARCH METHODS: We searched the Cochrane Pregnancy and Childbirth Group's Trials Register (5 November 2014), contacted investigators of the previously identified ongoing studies and scanned reference lists of retrieved studies. SELECTION CRITERIA: Randomised controlled trials (RCTs) of diet or exercise, or both, interventions for preventing excessive weight gain in pregnancy. DATA COLLECTION AND ANALYSIS: Two review authors independently assessed trials for inclusion and risk of bias, extracted data and checked them for accuracy. We organised RCTs according to the type of interventions and pooled data using the random-effects model in the Review Manager software. We also performed subgroup analyses according to the initial risk of adverse effects related to poor weight control. We performed sensitivity analysis to assess the robustness of the findings. MAIN RESULTS: We included 65 RCTs, out of which 49 RCTs involving 11,444 women contributed data to quantitative meta-analysis. Twenty studies were at moderate-to-high risk of bias. Study interventions involved mainly diet only, exercise only, and combined diet and exercise interventions, usually compared with standard care. Study methods varied widely; therefore, we estimated the average effect across studies and performed sensitivity analysis, where appropriate, by excluding outliers and studies at high risk of bias.Diet or exercise, or both, interventions reduced the risk of excessive GWG on average by 20% overall (average risk ratio (RR) 0.80, 95% confidence interval (CI) 0.73 to 0.87; participants = 7096; studies = 24; I(2) = 52%). This estimate was robust to sensitivity analysis, which reduced heterogeneity, therefore we graded this evidence as high-quality. Interventions involving low glycaemic load diets, supervised or unsupervised exercise only, or diet and exercise combined all led to similar reductions in the number of women gaining excessive weight in pregnancy.Women receiving diet or exercise, or both interventions were more likely to experience low GWG than those in control groups (average RR 1.14, 95% CI 1.02 to 1.27; participants = 4422; studies = 11; I(2) = 3%; moderate-quality evidence). We found no difference between intervention and control groups with regard to pre-eclampsia (RR 0.95, 95% CI 0.77 to 1.16; participants = 5330; studies = 15; I(2) = 0%; high-quality evidence); however, maternal hypertension (not a pre-specified outcome) was reduced in the intervention group compared with the control group overall (average RR 0.70, 95% CI 0.51 to 0.96; participants = 5162; studies = 11; I(2) = 43%; low-quality

low), preterm birth, pre-eclampsia or eclampsia, preterm pre-labor rupture of membranes, difficulty of labor (e.g., induction of labor and cesarean delivery) and maternal weight retention postpartum. Infant outcomes: birth weight and complication related to macrosomia including hypoglycaemia, hyperbilirubinaemia, infant birth trauma (palsy, fracture, shoulder dystocia), and respiratory distress syndrome. **Examine Cardiorespiratory Fitness as Outcome:** No	evidence).There was no clear difference between groups with regard to caesarean delivery overall (RR 0.95, 95% CI 0.88 to 1.03; participants = 7534; studies = 28; I(2) = 9%; high-quality evidence); although the effect estimate suggested a small difference (5%) in favour of the interventions. In addition, for combined diet and exercise counselling interventions there was a 13% (-1% to 25%) reduction in this outcome (borderline statistical significance).We found no difference between groups with regard to preterm birth overall (average RR 0.91, 95% CI 0.68 to 1.22; participants = 5923; studies = 16; I(2) = 16%; moderate-quality evidence); however limited evidence suggested that these effect estimates may differ according to the types of interventions, with a trend towards an increased risk for exercise-only interventions.We found no clear difference between intervention and control groups with regard to infant macrosomia (average RR 0.93, 95% CI 0.86 to 1.02; participants = 8598; studies = 27; I(2) = 0%; high-quality evidence), although the effect estimate suggested a small difference (7% reduction) in favour of the intervention group. The largest effect size occurred in the supervised exercise-only intervention group (RR 0.81, 95% CI 0.64 to 1.02; participants = 2445; studies = 7; I(2) = 0%), which approached statistical significance (P = 0.07). Furthermore, in subgroup analysis by risk, high-risk women (overweight or obese women, or women with or at risk of gestational diabetes) receiving combined diet and exercise counselling interventions experienced a 15% reduced risk of infant macrosomia (average RR 0.85, 95% CI 0.73 to 1.00; participants = 3252; studies = nine; I(2) = 0; P = 0.05; moderate-quality evidence)There were no differences in the risk of poor neonatal outcomes including shoulder dystocia, neonatal hypoglycaemia, hyperbilirubinaemia, or birth trauma (all moderate-quality evidence) between intervention and control groups; however, infants of high-risk women had a reduced risk of respiratory distress syndrome if their mothers were in the intervention group (RR 0.47, 95% CI 0.26 to 0.85; participants = 2256; studies = two; I(2) = 0%; moderate-quality evidence). AUTHORS' CONCLUSIONS: High-quality evidence indicates that diet or exercise, or both, during pregnancy can reduce the risk of excessive GWG. Other benefits may include a lower risk of caesarean delivery, macrosomia, and neonatal respiratory morbidity, particularly for high-risk women receiving combined diet and exercise interventions. Maternal hypertension may also be reduced. Exercise appears to be an important part of controlling weight gain in pregnancy and more research is needed to establish safe guidelines. Most included studies were carried out in developed countries and it is not clear whether these results are widely applicable to lower income settings.
Populations Analyzed: Female, Normal/Healthy Weight (BMI: 18.5–24.9), Overweight and Obese, Pregnant, Postpartum	**Author-Stated Funding Source:** National Institute for Health Research, Khon Kaen University, University of Liverpool, Thai Cochrane Network, Thailand Research Fund/Distinquished Professor Award, UNDP/UNFPA/UNICEF/WHO/World Bank Special Programme of Research, Development and Research Training in Human Reproduction (HRP), Department of Reproductive Health and Research (RHR), WHO.

<table>
<tr><td colspan="2">Systematic Review
Citation: Wolf HT, Owe KM, Juhl M, Hegaard HK. Leisure time physical activity and the risk of pre-eclampsia: a systematic review. Matern Child Health J. 2014;18(4):899-910. doi:10.1007/s10995-013-1316-8.</td></tr>
<tr><td>Purpose: To examine the association between leisure time PA before and/or during pregnancy and the risk of preeclampsia.</td><td rowspan="4">Abstract: Today, pre-eclampsia (PE) is one of the leading causes of maternal and perinatal morbidity and mortality. It has been proposed that leisure time physical activity (LTPA) is associated with a decreased risk of PE. The objective of this study was to perform a systematic literature review examining the association between LTPA before and/or during pregnancy and the risk of PE. A systematic search of the EMBASE and PUBMED databases from inception to November 17, 2011 was conducted by two independent reviewers. Only studies describing the association between the intensity or amount of LTPA before and/or during pregnancy and the risk of PE were included. A narrative synthesis of the results was undertaken following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines. A quality assessment was performed using the Newcastle Ottawa Scale. Eleven studies were included. None of the studies found light- or moderate-intensity LTPA to be associated with PE. Three studies reported that vigorous-intensity LTPA before and/or during pregnancy may reduce the risk of PE. One study reported a reduced risk among women who participated in LTPA at least 25 times per month or more than 4 h per week. However, one study found an elevated risk of severe PE with high amounts of LTPA, defined as 4.5 h per week or more. Results are mixed, but high intensity LTPA before and/or during pregnancy or more than 4 h per week of LTPA may reduce the risk of PE. However, an urgent need remains for high-quality studies including different ethnicities to further explore this relationship.</td></tr>
<tr><td>Timeframe: Inception–November 2011</td></tr>
<tr><td>Total # of Studies: 11</td></tr>
<tr><td>Exposure Definition: Leisure time PA, with the majority of the studies including sports activities, walking, and other recreational activities, such as gardening.
Measures Steps: No
Measures Bouts: No
Examines HIIT: No</td></tr>
<tr><td>Outcomes Addressed: Risk of preeclampisa (proteinuria and a diastolic blood pressure >90 mmHg and/or a systolic blood pressure >140 mmHg).
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 Reviews and Meta-Analyses Quality Assessment Chart

	Aune, 2014	Bonzini, 2007	da Silva, 2017	Di Mascio, 2016	Fazzi, 2017
Review questions and inclusion/exclusion criteria delineated prior to executing search strategy.	Yes	Yes	Yes	Yes	Yes
Population variables defined and considered in methods.	No	No	No	Yes	No
Comprehensive literature search performed.	Yes	Yes	Yes	Yes	Yes
Duplicate study selection and data extraction performed.	No	Yes	Yes	Yes	Yes
Search strategy clearly described.	Yes	Yes	Yes	Yes	Yes
Relevant grey literature included in review.	No	No	Yes	Yes	No
List of studies (included and excluded) provided.	No	No	No	No	No
Characteristics of included studies provided.	Yes	Yes	Yes	Yes	Yes
FITT defined and examined in relation to outcome effect sizes.	Yes	No	No	Yes	N/A
Scientific quality (risk of bias) of included studies assessed and documented.	No	Yes	Yes	Yes	Yes
Results depended on study quality, either overall, or in interaction with moderators.	N/A	Yes	No	Yes	No
Scientific quality used appropriately in formulating conclusions.	N/A	Yes	Yes	Yes	Yes
Data appropriately synthesized and if applicable, heterogeneity assessed.	Yes	Yes	Yes	Yes	N/A
Effect size index chosen justified, statistically.	Yes	Yes	Yes	Yes	N/A
Individual-level meta-analysis used.	No	No	No	No	N/A
Practical recommendations clearly addressed.	Yes	Yes	Yes	Yes	Yes
Likelihood of publication bias assessed.	Yes	Yes	No	Yes	No
Conflict of interest disclosed.	No	No	Yes	Yes	Yes

	Kasawara, 2012	Muktabhant, 2015	Wolf, 2014	Zheng, 2017
Review questions and inclusion/exclusion criteria delineated prior to executing search strategy.	Yes	Yes	Yes	Yes
Population variables defined and considered in methods.	No	Yes	No	No
Comprehensive literature search performed.	Yes	Yes	Yes	Yes
Duplicate study selection and data extraction performed.	No	Yes	Yes	No
Search strategy clearly described.	Yes	Yes	Yes	Yes
Relevant grey literature included in review.	No	No	No	Yes
List of studies (included and excluded) provided.	No	Yes	No	No
Characteristics of included studies provided.	Yes	Yes	Yes	No
FITT defined and examined in relation to outcome effect sizes.	Yes	No	N/A	No
Scientific quality (risk of bias) of included studies assessed and documented.	No	Yes	No	Yes
Results depended on study quality, either overall, or in interaction with moderators.	N/A	Yes	N/A	No
Scientific quality used appropriately in formulating conclusions.	N/A	Yes	N/A	No
Data appropriately synthesized and if applicable, heterogeneity assessed.	No	Yes	N/A	Yes
Effect size index chosen justified, statistically.	No	Yes	N/A	Yes
Individual-level meta-analysis used.	No	No	N/A	No
Practical recommendations clearly addressed.	Yes	Yes	Yes	Yes
Likelihood of publication bias assessed.	No	Yes	No	No
Conflict of interest disclosed.	Yes	Yes	No	No

Appendices

Appendix A: Analytical Framework

Topic Area
Pregnancy and Postpartum

Systematic Review Question
What is the relationship between physical activity and the incidence of preeclampsia and eclampsia?

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

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

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
Eclampsia
Preeclampsia

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

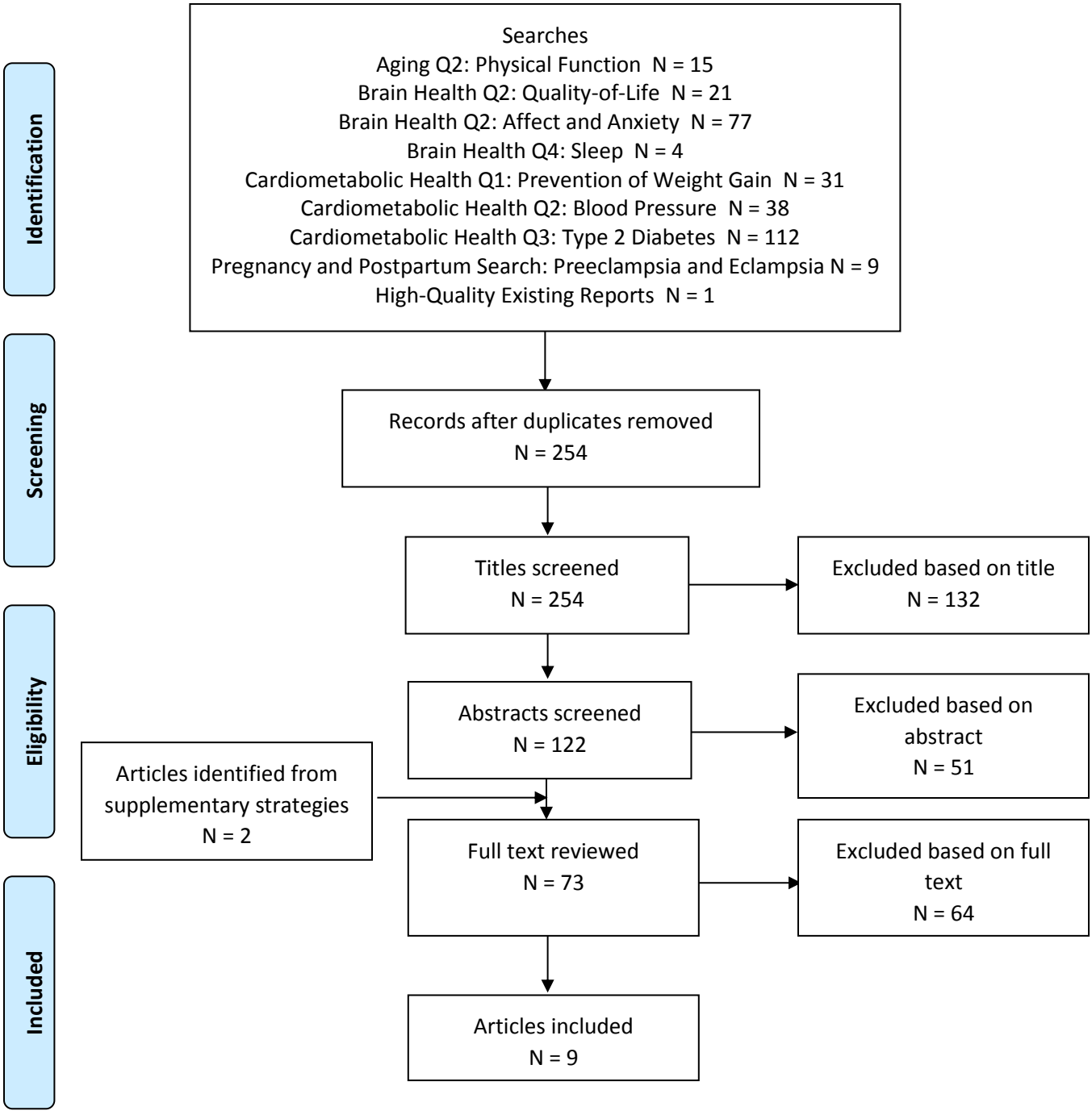
Set	Search Terms
Physical Activity	("Aerobic endurance" OR "Bicycl*" OR "Endurance training" OR "Exercise" OR "Exercises" OR "Free living activities" OR "Free living activity" OR "Functional training" OR "Leisure-time physical activity" OR "Lifestyle activities" OR "Lifestyle activity" OR "Muscle stretching 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[10, 11] 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 preeclampsia and eclampsia?

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:** • Eclampsia • Preeclampsia	

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, 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.	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		X				

Citation	Outcome	Population	Study Design	Exposure	Not ideal fit for replacement of de novo search	Other
diagnosed with gestational diabetes mellitus: a systematic review and meta-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			
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				
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:	X					

Citation	Outcome	Population	Study Design	Exposure	Not ideal fit for replacement of de novo search	Other
current status and future directions. *Evid Based Complement Alternat Med*. 2012;2012:715942. doi:10.1155/2012/715942.						
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					
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.	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
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.	X					
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					
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				
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.	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			

Citation	Outcome	Population	Study Design	Exposure	Not ideal fit for replacement of de novo search	Other
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					
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