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Benefits and Risk Associated With Physical Exercise During the Antenatal Period

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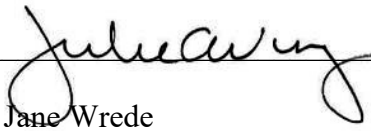
Project Advisor Signature: 

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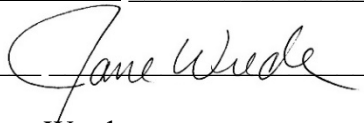
Second Reader Signature: 

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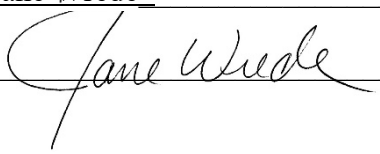
Director of Nurse-Midwifery Program Signature: 

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Corrie Crump and Brittany Freeman

Abstract

Background/Purpose: There are many misconceptions, uncertainties, and false narratives pertaining to how much physical activity and what types of activities are safe in pregnancy. This purpose of this critical literature review was to provide more guidance on evidence-based recommendations for what activity and how much activity is considered safe, and shed light on the proven benefits being physically active provides. Additionally, the literature was reviewed to assess the benefits of exercise during pregnancy as it pertains to maternal morbidity.

Theoretical Framework: Dorothea Orem's Theory on Self-Care Deficit explains the importance of self-care, and focuses on the individual's ability to perform self-care. Exercise during pregnancy can be viewed as a practice or type of self-care. It is also a known way to improve health and to maintain life and wellbeing. This theory guides our understanding of how a person's knowledge of potential health problems is needed for promoting self-care behaviors.

Methods: 20 scholarly articles were appraised in this review to identify the many health benefits of exercising while pregnant.

Results/Findings: The applicable findings of this critical review demonstrate that exercise during pregnancy improves the overall health-related quality of life and should be recommended for all eligible pregnant women (Montoya Arizabaleta et al., 2010). Pregnancy is a wonderful time to initiate new routines and healthy behaviors because pregnant women are highly motivated during this season of life.

Implications for Research Practice: Nurse-midwives are in a wonderful position to educate and counsel women on the many health benefits that exercising while pregnant has to offer. Pregnant women should be given evidenced-based information in regards to their health to assist them in

their decision making process. Nurse-midwives should help patients develop an exercise routine that is safe and sustainable. They also have the responsibility to be aware of lifestyle choices that can reduce harm, and positively impact pregnancy.

Keywords: Exercise in pregnancy, routine exercise, prevention, morbidity, gestational diabetes, preterm labor, low birth weight, premature rupture of membranes, and cervical insufficiency.

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Chapter I: Introduction

There are many misconceptions, uncertainties, and false narratives pertaining to how much physical activity and what types of activities are safe in pregnancy. Activity restrictions and bed rest have historically been prescribed when certain complications arise during the antepartum course. This paper was written to provide more guidance on evidence-based recommendations for what activity and how much activity is considered safe, and shed light on the proven benefits being physically active provides. Additionally, this paper will attempt to identify contraindications and potential complications of performing an exercise routine during pregnancy.

The benefits of aerobic exercise in the antepartum period include decreased incidence of gestational diabetes mellitus, decreased rates of operative vaginal births or cesarean deliveries, quicker postpartum recovery time, decreased musculoskeletal pain, and prevention of depressive disorders (The American College of Obstetricians and Gynecologists [ACOG], 2020). ACOG (2020) does not recommend that activity restrictions be prescribed as a way to prevent preterm birth and recognizes that it does not reduce complications associated with preeclampsia. Artal (2021) describes the benefits of exercise as having the same psychological and medical benefits for pregnant women as non-pregnant people. Additionally, Artal's (2021) systematic review demonstrated that exercise reduced the incidence of operative birth.

Statement of Purpose

The purpose of this paper is to perform a comprehensive literature review assessing the benefit of exercise during pregnancy as it pertains to maternal morbidity. The question being asked is: How does routine exercise during pregnancy affect morbidity compared to women who do not routinely exercise? Areas of focus will include risk reduction of illnesses (such as

pregnancy induced hypertension, gestational diabetes, perinatal depression, and mood disorders), length of labor, birth method, and physical discomforts of pregnancy. In addition to examining the benefits of exercise during pregnancy, the authors will try to identify any negative consequences associated with physical exertion to either mother or fetus. This paper was written with the intent of clarifying misconceptions and false information regarding physical exertion during pregnancy.

Evidence Demonstrating Need

Pregnant women are plagued with a wide variety of health complications unique to their gravid status. A pregnancy related death is demarcated as death occurring within one year of pregnancy, caused by either a pregnancy-related complication or by complication aggravated by pregnancy (Creanga et al., 2014). Each year there are 600,000 women are affected by a severe maternal morbidity in the United States (Creanga et al., 2014). While no standard definition exists, a maternal morbidity can be best described as any physical or psychological condition that arises from or is exacerbated by pregnancy and adversely affects a woman's health (Creanga et al., 2014). Risk factors include maternal age, chronic medical conditions, obesity, and cesarean delivery (Creanga et al., 2014). There is a need to examine how women and their providers can mitigate the effects of some of the modifiable risk factors. This review will help determine if an exercise routine is able to do just that.

Two common health complications pregnant women experience include gestational hypertension and gestational diabetes (Centers for Disease Control and Prevention [CDC], 2020a). Both of these conditions can lead to more severe pregnancy and long-term complications. Hypertension in pregnancy occurs in one out of every 12-17 pregnant women (CDC, 2020a). Gestational hypertension can lead to more severe complications such as

stroke, preeclampsia, eclampsia, or preterm birth (CDC, 2020a). Gestational diabetes is diabetes that a woman develops during pregnancy and is believed to affect between 1 in 20 and 1 in 50 expectant mothers (CDC, 2020b). Gestational diabetes can result in a macrocosmic infant, cesarean section delivery, a greater likelihood to develop preeclampsia, and the development of type 2 diabetes (CDC, 2020b). Infants born to mothers with gestational diabetes are at increased risk for childhood or adolescent obesity as well as diabetes (CDC, 2020b). Preventing illnesses such as these can reduce the incidence of more severe complications, improve quality of life, and lead to better overall health for both mother and baby.

Significance to Nurse-Midwifery

Exercise in pregnancy has many positive benefits for both the growing baby and for the mother. It is important for pregnant women to be informed to understand these benefits, and to implement these healthy lifestyle choices during their pregnancies. Many pregnant women are unaware of these benefits, and nurse-midwives need to do a better job of educating them. This is significant to midwifery because a few of the hallmarks are "incorporation of evidence-based care into clinical practice" and "utilization of health promotion, disease prevention, and health education" (ACNM, 2020, para. 6). Pregnancy is the perfect time to implement healthy changes because pregnant women are highly motivated toward healthy behaviors and they are under the close medical supervision of a healthcare provider during this time (Artal, 2021).

In 2020, the American College of Obstetricians and Gynecologists (ACOG) authored a Committee Opinion entitled *Physical Activity and Exercise During Pregnancy and the Postpartum Period.* In this document, ACOG recommends that all obstetric care providers encourage patients to exercise. This is an important component of optimal health. They discuss the benefits of exercising during pregnancy, including decreasing gestational diabetes mellitus,

fewer cesarean births and operative vaginal deliveries, and shortened postpartum recovery time; additionally, exercise can be an essential factor in the prevention of depressive disorders for postpartum women. Physical activity in pregnancy is associated with minimal risks, and benefits the majority of pregnant women (Artal, 2021). Modifications to exercise routines may be necessary though due to the physical changes that happen during pregnancy (Birsner & Gyamfi-Bannerman, 2020). There is no official position statement from the American College of Nurse-Midwives (2014), but in a patient education handout, they recommend pregnant women do moderate exercise for at least 30 minutes most days of the week.

According to the *Journal of Midwifery and Women's Health* (2014), most exercises are safe for pregnant women. Daily exercise while pregnant can reduce problems women may experience during their pregnancies. Exercise can help women feel better overall, and have less back pain, constipation, and tiredness (Exercise in Pregnancy, 2014).

An *Up To Date* entry by Artal (2021) explains how exercise in pregnancy is safe and can improve multiple pregnancy outcomes, including reduced frequency of excessive gestational weight gain, reduction of gestational diabetes, and retention of postpartum weight. The greatest barriers for exercise in pregnancy are nausea, fatigue, and an overall lack of time (Artal, 2021). Providers should focus on educating and intervening for these barriers that can help pregnant women achieve their exercise recommendations.

Theoretical Framework

Dorothea Orem was a nurse who had a goal of improving the quality of nursing in the hospital setting. Her Self-Care Deficit Theory will be used as the framework for this literature appraisal. Orem's nursing theory is comprised of three related parts: The theory of self-care, the theory of self-care deficit, and the theory of nursing system (Petiprin, 2020). Her theory focuses

on the individual's ability to perform self-care and is defined as "The act of assisting others in the provision and management of self-care to maintain or improve human functioning at home level of effectiveness" (Gonzalo, 2019, para. 3). Orem describes self-care as a practice of activities that an individual initiates and performs to maintain life, health, and well-being (Gonzalo, 2019).

Pregnancy can be a great time for women to acquire evidenced-based information on healthy behaviors because they are in frequent contact with their healthcare providers. Routine prenatal visits are important in developing the concept of knowledge. Many women are unsure of what types of exercises are safe in pregnancy, and this often leads to sedentary lifestyles. There is some evidence that information provided from prenatal care providers can affect women's commitment and beliefs about health behaviors such as exercise (Nicoloro-SantaBarbara et al., 2017). Positive self-care health behaviors such as adequate exercise, sleep, and proper nutrition all contribute to better birth outcomes (Nicoloro-SantaBarbara et al., 2017). In regards to exercise, it is important to remember that self-care requires the adaptation of each individual pregnancy.

Orem's Self-Care Theory includes the concepts of motivation, decision making, energy, and the knowledge necessary to carry out self-care actions (Hart & Foster, 1998). Each pregnant person should evaluate herself with her healthcare team to develop an exercise routine and a self-care regimen that is based on their personal needs while also balancing activities and rest. These routines may need to be altered throughout pregnancy, and this an example of Orem's modifying self-concepts to accept one's self as being in a particular state of health.

Orem's Nursing Theory has many different aspects that can be applied to a variety of patient situations. Several aspects within this theory can be directly related to self-care and

exercise during pregnancy. Pregnant women should be given evidenced-based information in regards to their health, and the benefits of self-care and exercise during pregnancy. These women may require alterations to their routines, or additional periods of rest. Referencing Orem's theory, pregnant women should be able to recognize hazards and incorporate modifications when necessary.

Summary

Midwives are placed in a variety of healthcare settings, and they are given the opportunity to educate many patients. An educational focus all midwives should have is informing patients about the many benefits of exercising during pregnancy, and helping them develop a physical activity/exercise plan that they feel comfortable and confident doing. A lack of education, information, and understanding can lead to sedentary lifestyles, and puts patients at risk for complications during their pregnancies, labors, births, and during the postpartum period. Pregnant women are highly motivated toward healthy behaviors (Artal, 2021), and nurse-midwives should be encouraging healthy and practical lifestyles.

Chapter Two will explain the methods used to explore scholarly literature that addresses the question of how routine exercise during pregnancy affects morbidity compared to women who do not routinely exercise during pregnancy. It will also include criteria for inclusion and exclusion of research studies, a summary of the selected studies, and evaluation criteria. Chapter Three is a literature review and analysis, a synthesis of the literature review matrix (see Appendix), a synthesis of major findings, and a critique of the strengths and weaknesses of the research. Chapter Four will discuss implications and conclusions, a literature synthesis, trends and gaps in the literature, implications for midwifery practice, recommendations for future research, and integration of the modeling and role modeling theory.

Chapter II: Methods

The purpose of this chapter is to describe the methods used to identify and critically appraise the literature to discover the benefits of exercising during the antenatal period. Multiple databases and search terms were utilized to gather literature. The process that was used to determine if the studies were relevant will be discussed, as well as the search strategies, and the inclusion and exclusion criteria. Lastly, this chapter will end with the evaluation criteria used to determine the level and quality of the literature being reviewed.

Search Strategies

The review of the literature includes studies that were dated between 1976 and 2020. Only articles that were published during or after 2010 were included in the research. Databases that were used include EBSCOhost, PubMed, and CINAHL. The key search terms included: exercise in pregnancy, routine exercise, prevention, morbidity, gestational diabetes, preterm labor, low birth weight, premature rupture of membranes, and cervical insufficiency.

An initial search on EBSCOhost resulted in 51 total articles dating from 2005 to 2020. When exclusion criteria was applied, it resulted in 34 articles. PubMed resulted in 92 total articles from 1976 to 2020, but only 73 articles were published between 2010 and 2020. A final CINAHL search resulted in 1,526 total articles. After exclusion criteria was applied, it resulted in 136 articles. Once duplicate articles were removed, the final 20 articles were selected when inclusion and exclusion criteria were met.

Criteria for Inclusion and Exclusion

The articles selected for this review of literature included research studies that evaluated the effects of exercising during pregnancy. Criteria for inclusion were: a human pregnancy of any gestation, research published within 10 years, randomized controlled trials, experimental

studies or quantitative non-experimental studies, any maternal age range, any level of physical activity, and any type of physical activity.

Exclusion criteria were studies that were not done with pregnant women, animal studies, articles published prior to 2010, literature reviews, meta-analyses and systematic reviews, articles that did not have the full-text available through interlibrary loan services, or studies published in languages other than English.

Summary of Selected Studies

Articles were comprised of research which took place in the United States, Spain, Australia, China, Canada, Sweden, Colombia, and Brazil. Only studies that were published in English were selected. All studies were published between 2010 and 2020. All articles included research that was conducted on humans. Studies involving research conducted on rodents or other animals were excluded.

Evaluation Criteria

The strength and quality of the articles were evaluated using the Johns Hopkins Research Evidence Appraisal Tool (Dearholt & Dang, 2012). Systematic reviews and meta-analyses were excluded during evaluation of results obtained through the search strategy discussed. Each article was assigned a strength grade of I-III. Level I evidence includes randomized controlled trials, experimental studies and explanatory mixed methods with only Level I quantitative studies. Level II studies include quasi-experimental studies and explanatory mixed methods with only Level II quantitative studies. Level III studies consist of quantitative non-experimental studies, explanatory mixed methods with only level III quantitative studies, quasi-experimental, or non-experimental studies (Dearholt & Dang, 2012). Of the 20 studies selected for review, there were 16 level I, two level II and two level III studies included in the review.

Selected studies were also assigned a rating based on the evidence of research. A grade of A denotes a high rating signifying consistent, generalizable results with a sufficient sample size, a satisfactory control, definitive conclusions, and consistent recommendations based on the findings (Dearholt & Dang, 2012). A grade of B denotes a good rating signifying reasonably consistent results, a sufficient sample size, some control, fairly definitive conclusions, and reasonably consistent recommendations based on the findings (Dearholt & Dang, 2012). Only studies with a quality rating of A or B were included in this analysis. Studies with a grade of C were not included due to little evidence with inconsistent results, an insufficient sample size, and no conclusions (Dearholt & Dang, 2012).

Summary

Searches of the databases EBSCOhost, PubMed, and CINAHL were conducted through Bethel University's online library and led to a quantity of results that was large enough to allow for high-quality research studies to be chosen for final review. It also allowed for the implementation of strict criteria to include only studies conducted on humans. The research was comprised of studies throughout the world, allowing for a decrease in cultural bias.

Chapter Three is a literature review and analysis, a synthesis of the matrix, a synthesis of major findings, and a critique of the strengths and weaknesses of the research. Chapter Four will discuss implications and conclusions, a literature synthesis, trends and gaps in the literature, implications for midwifery practice, recommendations for future research, and integration of the modeling and role modeling theory.

Chapter III: Literature Review and Analysis

This chapter will provide a synthesis of major findings as outlined in the matrix (see Appendix). It will analyze the statistical data brought forth by each study as it pertains to various topics surrounding maternal and neonatal well-being. This analysis will look at both positive benefits and any adverse outcomes attributed to physical exercise in pregnancy.

Synthesis of Matrix

The matrix was used to organize scholarly articles and identify significant outcomes of exercising during the antenatal period (see Appendix). The matrix includes fifteen randomized controlled trials, one prospective interventional controlled trial, one observational study, and three experimental studies. The level of evidence and quality of each research study was appraised using the Johns Hopkins Research Evidence Appraisal Tool (Dearholt & Dang, 2012). The matrix includes purpose, sample, setting, study design, results, strengths, limitations, level and quality of evidence, author recommendations, and a summary for current clinical practice. The matrix is organized alphabetically by author. The design, purpose, and pertinent findings of the studies were evaluated, and the synthesis of that data is described in Chapter Three.

Synthesis of the Major Findings

The 20 scholarly articles appraised in this review identify the many health benefits of exercising while pregnant. The synthesis of the major findings will address maternal and neonatal outcomes. Maternal outcomes addressed include musculoskeletal pain, length of labor, mode of delivery, hypertension in pregnancy, weight gain, gestational diabetes, preterm delivery, antepartum depression, preeclampsia, perineal integrity, and fatigue. The neonatal outcomes that were studied include birth weight and overall neonatal wellbeing.

Maternal Outcomes

While some studies looked at how exercise impacts a single factor in pregnancy, others studied how exercise impacts pregnancy as a whole. One example of the latter is a randomized controlled trial (RCT) conducted by Petrov Fieril et al. (2015) performed that studied the effects and safety of moderate to vigorous resistance exercise during pregnancy. An intervention group (N = 51) performed moderate to vigorous supervised resistance exercises twice a week. A control group (N = 41) received generalized exercise recommendations. This study revealed no significant difference in birthweight ($p = 0.059$), birth length ($p = 0.10$), or gestational age ($p = 0.16$), and no difference in cesarean rate (14% in intervention group and 15% in control group). The researchers concluded that resistance exercise does not jeopardize the health and wellbeing of pregnant women or their fetus during pregnancy, and it is an appropriate form of exercise in a healthy pregnancy (Petrov Fieril et al., 2015).

Another example of a study that looked at multiple factors was conducted by Kasawara et al. (2013) who enlisted 116 participants with chronic hypertension and/or a history of preeclampsia. Participants were randomly assigned to an intervention group (N = 56) or control group (N = 53). Study group participants performed 30 minutes of supervised physical exercise on a stationary bike once a week beginning between 12-20 weeks' gestation until the end of pregnancy. This study produced no differences between the two groups, comparing type of delivery; maternal outcomes, including admission to the intensive care unit and maternal morbidity; and neonatal outcomes, including appropriateness of weight to gestational age, birth weight, prematurity, one and five minute Apgar scores, admission to intensive unit care, and neonatal morbidity (Kasawara et al., 2013). Various aspects of this study are discussed in further detail in following sections.

Length of Labor

In a RCT conducted by Barakat et al. (2018) a control group (N = 253) performed a moderate aerobic exercise program three times a week throughout pregnancy. The researchers discovered that women in the control group had a shorter first stage of labor (409 vs 462 min., $p = 0.01$), shorter total duration of labor (450 vs 507 min., $p = 0.01$), and a shorter combined duration of first and second stages of labor (442 vs 499 min., $p = 0.01$). Author recommendations were that a supervised physical exercise program initiated early and continued throughout pregnancy can decrease the total time of labor (Barakat et al., 2018).

An observation study by Melzer et al. (2010) set out to study the association between recommended levels of physical activity during pregnancy and pregnancy outcomes. They recruited 27 active and 17 inactive women. This study assessed energy expenditure, aerobic fitness, and sleeping heart rate. Active women who performed at least 30 minutes of moderate physical activity daily had markedly better fitness and lower sleeping heart rate compared to the inactive group. This study also looked at length of labor and rates of operative delivery. Second stage of labor was 88 minutes in the active group and 146 minutes in the inactive group, ($p =$ .05). They concluded that 30 or more minutes per day of moderate physical activity may decrease the length of the second stage of labor and the frequency of operative delivery (Melzer et al., 2010).

Mode of Delivery

According to Melzer et al. (2010), 30 or more minutes per day of moderate physical activity is associated with a decrease in the frequency of an operative delivery. The authors studied the association between recommended levels of physical activity during pregnancy and

pregnancy outcomes. Operative delivery in the inactive compared with the active was 3.7 odds ratio (95% confidence interval, 0.87 – 16.08) (Melzer et al., 2010).

Kasawara et al. (2013) randomly assigned women with a history of either chronic hypertension or preeclampsia to an intervention group (N = 56), where participants performed stationary bike exercises one day a week throughout the duration of pregnancy, or a control group (N = 53). They found no difference in cesarean section rates ($p = 0.13$).

Hypertension in Pregnancy

Barakat et al. (2016) also performed a RCT looking at the relationship between an exercise program and gestational hypertension. In this study, 840 subjects demonstrated that pregnant women who did not exercise are three times more likely to develop hypertension (odds ratio [OR], 2.96; 95% confidence interval [CI], 1.29–6.81, $p = .01$) (Barakat et al., 2016).

In contrast, Fernandez-Buhigas et al. (2020) conducted a RCT which showed that systolic blood pressure (SBP) was lower in control groups compared to exercise groups, with SBP being higher at 27-28 weeks in the intervention group ($p = 0.010$). The intervention group participated in a mild-moderate supervised exercise program while a control group continued with routine pregnancy care. Limitations to this study included a small sample size of 92 participants and a high level of nulliparous women (Fernandez-Buhigas et al., 2020).

Maternal Weight Gain

It was discovered that pregnant women who do not exercise are 1.5 times more likely to gain excessive weight (OR, 1.47; 95% CI, 1.06–2.03, $p = .02$) (Barakat et al., 2016; Barakat et al., 2019). Ronnberg et al. (2015) enrolled an intervention group (N = 192) in physical activity at a moderate level of exertion for approximately 30 minutes per day. Compared to the control

group (N = 182) the intervention group's gestational weight gain was significantly lower (Ronnber et al., 2019).

Ruchat et al. (2012) developed a study in which pregnant women with a normal pre-pregnancy body mass index (BMI) were randomized to either a low-intensity (N = 23) or moderate-intensity (N = 26) exercise program, including nutritional control. The exercise programs consisted of walking sessions three to four times a week, increasing time from 25 to 40 minutes per session. A control group (N = 45) of pregnant women, also with normal pre-pregnancy BMI, did not participate in any structured exercise group. Results showed that women in the control group had higher gestational weight gain compared with the women in the exercise groups. Weight gain in the control group was 18.3 ± 5.3 kg, the low intensity group was 15.3 ± 2.9 kg ($p = 0.01$) and the moderate intensity group 14.9 ± 3.8 kg ($p = 0.003$). Excessive gestational weight gain in the low-intensity group was prevented in 70% of the women, and 77% in the moderate-intensity group. They concluded that prenatal nutrition and exercise programs reduce excessive gestational weight gain regardless of intensity. This impacts morbidity because excessive weight gain can lead to higher morbidity complications. In this study, 52% of the women who did not exercise during their pregnancies gained over the recommended gestational weight gain (Ruchat et al., 2012).

Gestational Diabetes

Another RCT, by Barakat et al. (2019), found subjects in their control group (N = 222) had a significantly higher prevalence of gestational diabetes than the intervention group (N = 234) who performed moderate aerobic exercise for 50-55 minutes three times per week throughout pregnancy. This study provides evidenced-based information that can be used to recommend supervised physical activity throughout pregnancy (Barakat et al., 2019).

Wang et al. (2017) conducted a study in which participants in an exercise group were prescribed cycling exercises to be performed at least 30 minutes three times per week until 37 weeks' gestation. The goal was to study the effects of this time of program on the incidence of gestational diabetes mellitus (GDM). Results showed 22% incidence of GDM in the exercise group versus 40.6% in the control group with a 95% confidence interval and a 45.8% reduction in GDM. This study did not include a dietary element. Additionally, there was no evidence that the exercise completed in this study increased the risk of preterm birth or reduced the mean gestational age at birth (Wang et al., 2017).

In contrast, an RCT by Ginar de Silva et al. (2017) showed no significant differences in the occurrence of GDM between an exercise group (N = 205) and a control group (N = 407); ($p = 0.056$). GDM results were collected through self-reporting. This was a secondary outcome of a larger study in which an exercise intervention was carried out three times per week for 16 weeks beginning in the second trimester (Ginar de Silva et al., 2017).

Preterm Delivery

Yet another study by Barakat et al. (2013) concluded that moderate exercise does not increase risk of preterm delivery when performed throughout pregnancy. Of the 290 study participants, the preterm rate in the exercise group was 4.3% compared to 7.2% in the control group ($p = 0.73$). A RCT conducted by Ginar de Silva et al., (2017) enrolled an intervention group (N = 213) into an exercise program for 16 weeks from 16-20 to 32-36 weeks' gestation. They found mean gestational age and preterm birth did not vary when compared to the control group (N = 426) (Ginar de Silva et al., 2017).

Kasawara et al. (2013) discovered that aerobic exercise was not linked to preterm delivery in women with a history of preeclampsia or chronic hypertension who participated in a stationary bike program one day per week throughout pregnancy ($p = 0.10$).

Antenatal Depression

El-Rafie et al. (2016) studied the effects of an exercise program on antenatal depression. The exercise group, N = 50, showed a significant improvement in depressive symptoms compared to the control group, with N = 50 ($p = 0.001$). The exercise group participated in a supervised 12-week exercise program during their second and third trimester. Exercise included walking, aerobic exercise, stretching, and relaxation, in addition to normal antenatal care (El-Rafie et al., 2016). In a study conducted by Robledo-Colonia et al. (2012) an exercise group (N = 40) completed a three-month supervised exercise program beginning between 16 and 20 weeks' gestation. The sessions were three times a week, and included walking, aerobic exercise, stretching, and relaxation. Measurements were recorded on the Center for Epidemiological Studies Depression Scale (CES-D). The exercise group reduced their depressive symptoms on the CSE-D questionnaire by four points more than the control group. It was also observed that no adverse events occurred during or after the exercise (Robledo-Colonia et al., 2012). Additionally, Watson et al. (2018) concluded that maintaining levels of early pregnancy exercise throughout the pregnancy and postpartum period shows a potential benefit for depressive and anxious symptoms. This study showed a reciprocal relationship between exercise and depressive symptoms in the perinatal period ($p = .095$). Conversely, Montoya Arizabaleta et al. (2010) did not show a significant effect for the exercise group in the mental component of their study.

Preeclampsia

The RCT by Ginar de Silva et al., (2017) set out to study the effectiveness of an exercise program on preventing negative maternal outcomes. Their goal was to determine if exercise was a preventative strategy for common maternal and neonatal adverse health outcomes, based on the current recommendations that moderate-intensity physical exercise be recommended to women with uncomplicated pregnancies. Given that preeclampsia and cardiovascular disease share similar risk factors, it has been thought that exercise may also be protective for preeclampsia. However, this study showed no significant differences in the occurrence of preeclampsia ($p > 0.05$).

Kasawara et al. (2013) concluded that pregnant women with chronic hypertension or history of preeclampsia, including those who were previously sedentary, may initiate physical exercise with adequate supervision. The preeclampsia reoccurrence rate was 4.6% and included two participants from the study group and three from the control group (Kasawara et al., 2013).

Perineal Integrity

A study by Rodríguez-Blanque et al. (2019) examined the effects of an aquatic exercise routine and perineal integrity. The results showed that women in the exercise group had a greater rate of intact perineum compared to the women in the control group (OR = 13.54, 95% CI [2.75, 66.56]). After adjusting for infant birth weight this study showed an OR of 8.57 (95% CI [1.85, 39.68]. Additionally, maternal weight gain did not affect the odds for intact perineum (OR = 1.072, 95% CI [0.896, 1.283]). Women who suffer from an extensive perineal tear have higher rates of morbidity. Water exercise during pregnancy is shown to reduce this risk and to help women have intact perineum after childbirth (Rodríguez-Blanque et al., 2019).

Quality of Life

Fatigue

Fatigue and low energy are common complaints of women in pregnancy and are also associated with decreased quality of life and increased risk for cesarean section (Ward-Ritacco et al., 2016). To determine if muscle strengthening exercises during pregnancy are associated with increased energy and reduced fatigue, Ward-Ritacco et al. (2016) enrolled 26 women to perform six low-to-moderate intensity resistance exercises twice per week for 12 weeks, from 23 to 35 weeks' gestation. Results showed that resistance exercises increased physical and mental energy in 92-96% of workouts ($p = 0.136$ & $p = 0.242$) and decreased physical and mental fatigue in 79-88% of workouts ($p = 0.067$ & $p = 0.06$) (Ward-Ritacco et al., 2016).

Musculoskeletal Pain

A randomized control trial by Backhausen et al. (2017) studied the effects of an aquatic exercise program on low back pain in healthy pregnant women. They found low back pain to be much lower in the exercise group (2.01) compared to the control group (2.38), $p = 0.04$. However, the results were of questionable clinical significance. Ultimately, it was concluded that an unsupervised water exercise program might have a small positive effect on low back pain in pregnancy and is feasible and safe (Backhausen et al., 2017).

An RCT designed to study the effects of an aerobic exercise routine on nulliparous women, conducted by Montoya Arizabaleta et al. (2010), had 64 participants randomly assigned to an intervention (N = 24) or control group (N = 26), with the intervention group performing an exercise routine that included walking for 10 minutes, aerobic exercise for 30 minutes, stretching for 10 minutes, and relaxation for 10 minutes over a three-month period beginning at 16-20 weeks' gestation. Albeit the small sample size, the intervention group had improved their health-

related quality of life when compared to the control group. Results were measured via questionnaire and showed improved quality of life in the physical component domains with physical function having a CI of 95%, bodily pain with a CI of 95%, and the general health domain with a CI of 95% (Montoya Arizabaleta et al., 2010).

Neonatal Outcomes

Neonatal Birth Weight

Barakat et al. (2016) conducted a study to determine if adherence to an exercise program was protective against macrosomia or low birth weight infants. They discovered that pregnant women who do not exercise are two and a half times more likely to deliver a macrosomic baby (OR, 2.53; 95% CI, 1.03–6.20, p = .04) (Barakat et al., 2016). The study by Melzer et al. (2010), as discussed previously, showed a birthweight, maternal weight gain, and parity adjusted odds ratio of 7.6 (95% confidence interval, 1.23–45.8). They concluded that moderate physical activity is associated with improved cardiovascular fitness, showing no negative fetal effects or labor and delivery outcome (Melzer et al., 2010).

Overall Wellbeing

A study by Ginar de Silva et al. (2017) studied the usefulness of an exercise program on preventing negative newborn health outcomes. This study showed no statistical difference in mean birth weight ($p = 0.63$), length ($p = 0.33$), and head circumference ($p = 0.34$). Szymanski et al. (2012) designed a study to determine if vigorous exercise had any negative consequences to the fetus. Umbilical artery Doppler indices, fetal heart tracing/rate, uterine artery doppler scans and biophysical profiles (BPP) were evaluated before and after exercise; 15 non-exercising women, 15 regularly active women and 15 highly active women participated in a treadmill test until volitional fatigue was reached at 28 -32weeks 6 days' gestation. Umbilical and uterine

artery Doppler indices were comparable among both activity groups; they did not change with exercise ($P > .05$). BPP and fetal heart tracings were reassuring in all groups. They concluded that fetal well-being was reassuring after a short duration of vigorous exercise in both active and sedentary pregnant women. One limitation to this study was that fetal wellbeing was not monitored during exercise (Szymanski et al., 2012).

Critique of Strengths and Weaknesses

This analysis includes 16 level I, two level II and two level III studies. Included were 15 RCTs, one prospective interventional study, one observational study, and three qualitative studies. One strength of the selected studies was that many had large sample populations with high adherence rates. Other strengths were that studies were conducted in various countries with participants of various cultures and backgrounds. A limitation noted was that several studies were non-blinded. Other studies had the limitation of a small sample size, while some studies had a high participant dropout or disqualification rate. Another limitation discovered was uneven distribution of control and intervention group participants in several studies. While the studies summarized had an overwhelming amount of evidence to support exercise in decreasing maternal morbidity, most of the studies were conducted on nulliparous women without previous adverse health concerns. A beneficial area for future research would be studies on multiparous women with identified health complications during pregnancy.

Summary

This chapter demonstrated the numerous positive benefits that physical exercise during pregnancy can provide. It also examined a few contrasting studies which outlined several potential consequences or inconclusive recommendations. Chapter Four will discuss implications and conclusions, a literature synthesis, trends and gaps in the literature, implications for

midwifery practice, recommendations for future research, and integration of the modeling and role modeling theory.

Chapter IV: Discussion, Implications, and Conclusions

The purpose of this review was to discover if antenatal exercise has a positive effect on the mother and baby dyad. There were 20 pertinent scholarly articles chosen for critical analysis using the Johns Hopkins Research Evidence Appraisal Tool. After the research was completed, nurse-midwifery implications and absences in the existing literature were discovered. Chapter Four will discuss the implications for midwifery practice and areas where further research is needed. The chapter will conclude with the integration of Dorothea Orem's nursing theory with respect to the interventions that were beneficial to pregnant women.

Literature Synthesis

The research question that formed the structure of this critical review is whether routine exercise during pregnancy affects morbidity compared to women who do not routinely exercise during pregnancy. There were many variables taken into consideration, and the results largely showed exercise during pregnancy having positive effects for the pregnant woman, the baby, and even during the immediate postpartum period. Nicoloro-SantaBarbara et al. (2017) showed that pregnant women are unaware of which exercises are safe during pregnancy. This could lead to pregnant women not exercising. Inactivity during pregnancy can result in complications that could be negated with exercise (Baraka et al., 2016). Nurse-midwives are responsible for informing patients of the many health benefits of exercising during pregnancy.

Current Trends

The vast majority (N = 10) of studies analyzed suggested that maternal exercise can be a preventative measure for hypertension, excessive gestational weight gain, gestational diabetes, large-for-gestational-age infants, and postpartum depression (Baraka et al., 2016; Barakat et al., 2019; El-Rafie et al., 2016; Fernandez-Buhigas et al., 2020; Kasawara et al., 2013; Robledo-Colonia et al., 2012; Ronnberg et al., 2015; Ruchat et al., 2012; Wang et al., 2017; Watson et al.,

2018). Exercise throughout pregnancy can be used to maintain or improve the quality of life for pregnant women (Barakat et al., 2019).

One factor that affects quality of life and was measured in several studies is antenatal depression (El-Rafie et al., 2016; Fernandez-Buhigas et al., 2020; Robledo-Colonia et al., 2012; Watson et al., 2018). This is a common condition and can be linked with a higher risk of adverse pregnancy outcomes (El-Rafie et al., 2016). Depression during pregnancy is associated with an increased risk of prenatal and perinatal complications. Physical activity during pregnancy positively affects both mom and baby and is an effective therapy for depression (Robledo-Colonia et al., 2012). As a solution, an exercise regimen could be promoted as an important and cost-effective method to positively reduce depressive symptoms (El-Rafie et al., 2016). There is a positive correlation between exercise and mental health during pregnancy, especially for women previously diagnosed with depression (Watson et al., 2018). Exercise should be encouraged for as women are often more motivated to improve their health to benefit their children, and pregnancy is a great opportunity to assume healthy lifestyle changes.

Another factor affecting quality of life is fatigue and reduced energy (Ward-Ritacco et al., 2016). These are complaints pregnant women often experience and are often inadequately managed (Ward-Ritacco et al., 2016). Short sessions of resistance exercise has been consistently associated with decreases in feelings of fatigue rises of feelings of energy during the second and third trimesters (Ward-Ritacco et al., 2016). Providers should be encouraging resistance exercise to patients, especially those who are experiencing fatigue and a lack of energy. This is a simple way to help increase the patients' energy during the second and third trimesters.

A common complaint during pregnancy is back pain. In a trial by Backhausen et al. (2017) suggests water exercises might have a positive effect on low back pain in pregnancy. This

is a safe and feasible type of exercise for pregnant patients (Backhausen et al., 2017). Another benefit of water exercise during pregnancy is that it reduces the risk of perineal tears and helps women have intact perineum after childbirth (Rodríguez-Blanque et al., 2019). Many women question if there is anything they can do to help reduce the risk of tearing during labor. Encouraging pregnant women to exercise in water is a safe and effect way to reduce the risk of perineal tearing during birth.

The length of labor is something many providers and patients wish they could know. Labor is typically unpredictable, and the duration is unknown. It was discovered in a trial by Barakat et al. (2018) that a supervised physical exercise program initiated early and continued throughout pregnancy decreases the total time of labor. Providers can use this information to encourage patients to exercise during their pregnancies.

Mode of delivery is another important factor that effects maternal morbidity. At least 30 minutes per day of moderate physical activity is associated with a decrease in the frequency of an operative delivery (Melzer et al., 2010). Exercise can reduce the need for an assisted vaginal delivery. Increasing spontaneous vaginal births will decrease morbidity related to operative deliveries.

Kasawara et al. (2013) linked obesity to an increased risk of cesarean section. They discovered that morbidly obese pregnant women had a two- to threefold increased risk of cesarean section, in comparison to normal weight pregnant women. The risk increased equivalently to an increase in BMI in overweight (OR = 1.46, 95% CI 1.34–1.60), obese (OR = 2.05, 95% CI 1.86–2.27), and morbidly obese (OR = 2.89, 95% CI 2.28–3.79) pregnant women (Kasawara et al., 2013). When counseling women who have a high BMI, it is important to let

them know of their increased risk of a cesarean section. One way they can help reduce this risk is to start an exercise routine that they feel safe and confident doing.

Exercising during pregnancy does not place a woman at risk for preterm delivery. In a study by Barakat et al., (2013) it was concluded that moderate exercise does not increase the risk of preterm delivery when performed throughout pregnancy. This is encouraging information that providers can share with patients who are anxious about exercising during pregnancy.

Gaps in the Literature

Several studies showed rather inconclusive results (Fernandez-Buhigas et al., 2020; Ginar de Silva et al., 2017; Szymanski et al., 2012). A RCT conducted by Fernandez-Buhigas et al. (2020) found no differences in pregnancy weight, fasting glucose, aspartate-amino-transferase, alanine-amino-transferase, blood creatinine, or blood uric acid between intervention and control groups. The study by Ginar de Silva et al. (2017) did not prove benefits of exercise during pregnancy on preventing preeclampsia or preterm birth; however, it did not demonstrate any adverse health outcomes on newborns either. The results of this study should be interpreted with caution due to a lack of statistical power and low compliance. The study had several limitations: a higher number of dropouts in the intervention group, failure to follow nutritional intake, self-reporting of preeclampsia, intervention timing which overlapped with the usual onset of preeclampsia and preterm birth, and a very healthy sample population resulting from strict eligibility criteria (Ginar de Silva, 2017). While results did not necessarily prove benefit, they also did not demonstrate harm.

It is uncertain if there is an upper limit threshold for exercise intensity and unclear how strenuous physical activity affects a fetus. It is also unknown if there is a point at which fetal well-being is compromised (Szymanski et al., 2012). However, it has been reasonably concluded

that it is safe for healthy pregnant women to follow ACOG's recommendation to participate in at least 30 minutes of moderate physical activity per day.

Rest has been the usual recommendation to prevent morbidity associated with hypertension in pregnant women. In a study by Kasawara et al., (2013), it was determined there is a significant lack in evidence to recommend regular rest as a method to prevent preeclampsia or complications from preeclampsia from developing. Due to the proven benefits that exercises has and the lack of evidence to support rest, providers need to encourage exercise and discourage rest as a way to reduce morbidity.

Implication for Midwifery Practice

Nurse-midwives are in an excellent position to educate patients on the benefits of exercising during pregnancy, and to help them develop an exercise routine that is safe and sustainable. They also have the responsibility to be aware of lifestyle choices that can reduce harm, and positively impact pregnancy. Maintaining a physically active lifestyle has many health benefits for both the mother and the baby, and nurse-midwives can help to improve the overall health outcomes by educating and encouraging patients to exercise while pregnant.

Midwives historically promote low intervention lifestyles. Exercise has clear benefits in improving several common discomforts of pregnancy such as back pain, fatigue, and constipation. Practical ways midwives can apply this information into practice is to educate every patient on the benefits of exercise. Whenever a midwife is counseling someone who is at risk for depression, their plan of care should include exercise and also inform them of how exercise reduces depression rates.

Recommendations for Future Research

Throughout the research appraisal process, several areas for continuing research were discovered. These include researching how nurse-midwives conduct exercise education and evaluating the patients' understanding of the information.

Patients receive and understand information in a variety of ways. Providers need to have an understanding of how an individual patient learns best and adapt patient education to their specific needs. With the majority of pregnant women not partaking in regular exercise, it is crucial that information is provided to patients in ways they can understand.

Another recommendation for future research is evaluating a patients' understanding of information after they have been educated on the benefits of exercising while pregnant. Providers need to do a better job of educating patients, and need to make sure the patients actually have an understanding of the information. If a provider discovers that a patient did not understand the information, they should alter their education delivery to that specific patient's needs.

The effects of high intensity physical activity on pregnancy outcomes should be further researched. Low impact and low to moderate intensity exercises are the focus of existing studies in the current research. Specific types of exercises including heavy weight lifting and long distance running need to be evaluated.

Other recommendations for future research include more studies on the effects of exercise on the mode of delivery such as spontaneous vaginal birth compared with operative vaginal birth and cesarean section birth.

Theoretical Framework: Orem's Self-Care Deficit Theory

Dorothea Orem's Theory on Self-Care Deficit explains the importance of self-care, and focuses on the individual's ability to perform self-care. Orem describes self-care as a practice of

activities that an individual initiates and performs to maintain life, health, and well-being (Gonzalo, 2019). Exercise during pregnancy can be viewed as a practice or type of self-care. It is also a known way to improve health and to maintain life and wellbeing. This theory guides our understanding of how a person's knowledge of potential health problems is needed for promoting self-care behaviors. Orem's Theory includes the concepts of motivation, decision making, energy, and the knowledge necessary to carry out self-care actions (Hart & Foster, 1998).

Pregnancy is commonly a time whenever women are highly motivated toward healthy behaviors (Artal, 2021). Nurse-midwives should use this motivation to encourage healthy and practical lifestyles. Exercise needs to be highly recommended to pregnant patients.

Pregnant women should be given evidenced-based information in regards to their health to assist them in their decision making process. Having knowledge of the benefits of self-care and exercising during pregnancy is needed to promote this healthy practice. Pregnant women should be able to recognize hazards and incorporate modifications when necessary.

Conclusion

The applicable findings of this critical review demonstrate that exercise during pregnancy improves the overall health-related quality of life and should be recommended for all eligible pregnant women (Montoya Arizabaleta et al., 2010). The 20 scholarly articles, chosen for critical analysis using the Johns Hopkins Research Evidence Appraisal Tool with statistically significant results, affirm that antenatal exercise has many positive benefits. Nurse-midwives are in a position to educate and counsel women on the many health benefits that exercising while pregnant has to offer. Pregnancy is a wonderful time to initiate new routines and healthy behaviors because pregnant women are highly motivated during this season of life.

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Appendix 1

Source: Backhausen, M., Tabor, A., Albert, H., Rosthoj, S., Damm, P. & Hegaard, H. (2017). The effects of an unsupervised water exercise program on low back pain and sick leave among healthy pregnant women – A randomized controlled trial. *PLoS One, 12*(9), e0182114. https://doi.org/10.1371/journal.pone.0182114

Purpose/Sample	**Design (Method/Instruments)**	**Results**	**Strengths/Limitations**
Purpose: To observe the effect of an aquatic exercise program on low back pain and sick leave among healthy pregnant women. **Sample/Setting:** 516 healthy pregnant women **Level of evidence:** I **Quality of evidence:** A	Participants were randomly assigned to either unsupervised water exercise twice a week for a duration of 12 weeks or routine prenatal care. Low back pain intensity was measured by the Low Back Pain Rating scale at 32 weeks' gestation while sick leave days were self-reported.	Lower back pain was much lower in the exercise group (score 2.01) vs the control group (2.38) $p = 0.04$ There was no difference in the reported days spent on sick leave. $p = 0.83$ **Conclusion:** Unsupervised aquatic exercise results in a statistically significant lower intensity of low back pain in healthy pregnant women; however, the result is probably not clinically significant. The number of days spent on sick leave were not affected.	**Strengths:** The study was highly feasible, compliance was good, and only one participant dropped out. **Limitations:** Participants were very healthy, had higher education, had low BMI, were non-smokers, lived with a partner, and were physically active at baseline, leading to decreased generalizability. Investigators and participants were not blinded.

Author Recommendations:
Unsupervised water exercises have a minor positive effect on low back pain; however, this may not be clinically significant. The effect on sick days remains unchanged.

Summary for current clinical practice question:
A water exercise program is feasible and safe to do in a population of healthy pregnant women.

Source: Barakat, R., Franco, E., Perales, M., López, C., & Mottola, M. (2018). Exercise during pregnancy is associated with a shorter duration of labor: A randomized clinical trial. *European Journal of Obstetrics and Gynecology, 224*, 33–40. https://doi.org/10.1016/j.ejogrb.2018.03.009

Purpose/Sample	**Design (Method/Instruments)**	**Results**	**Strengths/Limitations**
Purpose: The purpose of this study was to observe the impact of an exercise program throughout pregnancy on the duration of labor. **Sample/Setting:** 572 pregnant women were recruited during the first prenatal visit at 9–11 weeks and were informed about the study and assessed for eligibility. Women with uncomplicated pregnancies with no history or risk of preterm delivery were invited to participate. **Level of evidence:** 1 **Quality of evidence:** A	A RCT was used where 508 healthy pregnant women were randomly assigned between 9-11 weeks' gestation to either a control group (N = 253) or an exercise group (N = 255). A moderate aerobic exercise program, used 3x a week throughout pregnancy was the intervention. The women assigned to the control group received standard care from health professionals. Women who were assigned to the exercise group received similar standard care and performed an exercise program throughout their pregnancy.	Women randomized to the EG had shorter first stage of labor (409 vs 462 min., $p = 0.01$), total duration of labor (450 vs 507 min., $p = 0.01$) as well as combined duration of first and second stages of labor (442 vs 499 min., $p = 0.01$). Results also showed women in the intervention group were less likely to use an epidural, and the prevalence of neonate macrosomia was higher in the control group. **Conclusion:** A supervised physical exercise program throughout pregnancy decreased the duration of the first phase of labor as well as total time of the first two phases, leading to a reduction in overall labor time.	**Strengths:** A large RCT with high adherence. Another strength of the study was the analysis of the timing of the labor stages because labor duration was defined through consistent and similar methods by the hospital nursing staff. **Limitations:** Nutrition or energy intake was not assessed. However, all pregnant women had standard care and regular information regarding a healthy lifestyle during pregnancy.

Author Recommendations:
A supervised physical exercise program initiated early and continued throughout pregnancy decreases the total time of labor. Future research should examine the influence of programmed, supervised exercise on maternal and fetal perinatal results.

Summary for current clinical practice question:
This research shows that regular exercise decreases the duration of labor, decreases overall maternal weight gain, and reduces the prevalence of neonate macrosomia.

Source: Barakat, R., Pelaez, M., Cordero, Y., Perales, M., Lopez, C., Coteron, J., & Mottola, M. (2016). Exercise during pregnancy protects against hypertension and macrosomia: Randomized clinical trial. *American Journal of Obstetrics and Gynecology*, *214*(5), 649.e1–649.e8. https://doi.org/10.1016/j.ajog.2015.11.039

Purpose/Sample	**Design (Method/Instruments)**	**Results**	**Strengths/Limitations**
Purpose: This was done to examine the influence of a program of supervised exercise throughout pregnancy on the frequency of pregnancy-induced hypertension. **Sample/Setting:** 840 healthy women were randomized to either an exercise intervention or a usual care group. A final total of 765 women was analyzed. **Level of evidence:** 1 **Quality of evidence:** A	A RCT was used where women were randomized into an exercise group (N = 382) or a control group (N = 383) receiving standard care. The exercise group trained 3 days a week from 9-11 weeks' gestation to 38-39 weeks' gestation.	Pregnant women who did not exercise were 3 times more likely to develop hypertension and 1.5 times more likely to gain excessive weight. Pregnant women who did not exercise were also 2.5 times more likely to deliver a large baby. **Conclusion:** Maternal exercise may be a preventative tool for hypertension and excessive gestational weight gain, and may control the baby's birth weight.	**Strengths:** This was a large RCT with high adherence. None of the control women were excluded. **Limitations:** Nutrition, energy intake, and occupational job stress were not assessed in the participants.

Author Recommendations: Because of the accomplishments with the exercise program, perhaps more clinics and hospitals should have this type of exercise program available.

Summary for current clinical practice question:
This research proves that regular exercise during pregnancy decreases the incidence of hypertension, future cardiovascular disease, and obesity risks.

Source: Barakat, R., Refoyo, I., Coteron, J., & Franco, E. (2019). Exercise during pregnancy has a preventative effect on excessive maternal weight gain and gestational diabetes. A randomized controlled trial. *Brazilian Journal of Physical Therapy*, *23*(2), 148–155. https://doi.org/10.1016/j.bjpt.2018.11.005

Purpose/Sample	**Design (Method/Instruments)**	**Results**	**Strengths/Limitations**
Purpose: The purpose of this study was to examine the effects of an exercise program throughout pregnancy on maternal weight gain and prevalence of gestational diabetes. **Sample/Setting:** 594 healthy pregnant women from primary care medical centers in Spain were recruited during their first prenatal appointment. **Level of evidence:** 1 **Quality of evidence:** A	A RCT was done that included an exercise intervention group (EG) and a standard care control group (CG). The exercise intervention had moderate aerobic exercise that was done 3x per week. Intervention started between 8-10 weeks' gestation and went until 38-39 weeks. The sessions were 50-55 min. long. All of the women received similar prenatal care. 594 pregnant women were assessed for eligibility and 456 were included in the study. The women were randomly allocated to the groups. The EG had N = 234 and the CG had N = 222.	The CG showed a higher percentage of pregnant women gaining excessive weight, and they also had a significantly higher prevalence of gestational diabetes than in the EG. **Conclusion:** The results of this trial show that exercise throughout pregnancy can reduce the risk of gestational diabetes and excessive maternal weight gain.	**Strengths:** They had a large number of participants in the RCT, and these women had high adherence to the intervention. **Limitations:** Energy intake and nutritional habits were not assessed in this study.

Author Recommendations:
This study provides evidenced-based information that can be used to recommend supervised physical activity throughout pregnancy.

Summary for current clinical practice question:
Exercise throughout pregnancy can be used to maintain or improve the quality of life for pregnant women.

Source: Barakat, R., Roman, I. R., Pelaez, M., & Coteron, J. (2013). Exercise throughout pregnancy does not cause preterm delivery: A randomized, controlled trial. *Journal of Physical Activity and Health, 11*(5), 1012-1017. https://doi.org/10.1123/jpah.2012-0344

Purpose/Sample	**Design (Method/Instruments)**	**Results**	**Strengths/Limitations**
Purpose: To explore the effects of exercise during an entire pregnancy on gestational age at time of delivery. Gestational weight gain, type of delivery, blood pressure, 1 h glucose tolerance test, birth weight/length, pH of umbilical cord and Apgar scores were also measured. **Sample/Setting:** 320 Caucasian (Spanish) women with a singleton gestation. OB department of a hospital in Madrid, Spain. **Level of evidence:** I **Quality of evidence:** A	320 Caucasian women with a singleton gestation were randomly assigned to an exercise (N = 160) or control (N = 160) group.	Of 290 participants, the mean gestational age did not differ between groups. 4.3% were preterm in exercise group. 7.2% preterm in control group. I = 0.73. **Conclusion:** Moderate exercise does not increase risk of preterm delivery when performed throughout pregnancy.	**Strengths:** Intervention with an appealing exercise program with various activities that gave pregnant women significant improvements. **Limitations:** Non-blinded, marital status and socioeconomic status not considered, other physical activity outside of the program was not measured.

Author Recommendations:
Moderate supervised exercise throughout pregnancy does not increase risk of preterm delivery for healthy pregnant women, while.

Summary for current clinical practice question:

If supervised and performed by healthy women with a singleton gestation, exercise during pregnancy does not increase the likelihood of a preterm delivery and offers additional health benefits.

Source: El-Rafie, M. M., Khafagy, G. M., & Gamal, M. G. (2016). Effect of aerobic exercise during pregnancy on antenatal depression. *International Journal of Women's Health*, *8*, 53–57. https://doi.org/10.2147/IJWH.S94112

Purpose/Sample	**Design (Method/Instruments)**	**Results**	**Strengths/Limitations**
Purpose: Antenatal depression is common and can be associated with a greater risk of negative pregnancy outcomes. The purpose of this study was to see the effect of exercise in preventing and treating antenatal depression. **Sample/Setting:** 120 pregnant women aged 20-35 in their second trimester were enrolled. 10 women from each group did not finish the study, so 100 women were analyzed. **Level of evidence:** 1 **Quality of evidence:** B	This study was a prospective interventional controlled trial. 100 women from Cairo, Egypt participated. They were divided into 2 groups, an exercise group (EG) (N = 50), and a control group (CG) (N = 50). The exercise group had regular, supervised session for 12 weeks. Their exercise included walking, aerobic exercise, stretching, and relaxation, in addition to normal antenatal care. The CG had their usual antenatal care. Both groups were given the Center for Epidemiological Studies Depression Scale (CES-D) at their first interview and again immediately after the 12-week intervention.	The exercise group showed a significant improvement in depressive symptoms compared to the control group after the 12-week intervention on the CES-D (p = 0.001). 5-point improvement on the 20-point scale. The CG demonstrated no significant changes over time, while the EC demonstrated a significant improvement of depressive symptoms. **Conclusion:** Exercise in pregnancy was positively associated with a reduction in depression symptoms.	**Strengths:** High adherence to the EG that showed significant positive improvements. **Limitations:** This was a small trial where the participants and physicians were not blinded. The feasibility of physical activity during pregnancy may be affected by barriers such as child care, work commitments, and pregnancy symptoms.

Author Recommendations: Exercise should be promoted as women are often highly motivated to improve their health to benefit their children, and pregnancy represents an ideal opportunity to adopt healthy lifestyle changes.

Summary for current clinical practice question:
The findings reveal the importance and cost-effectiveness of supervised exercise during pregnancy in improving antenatal mood changes, and providing other health benefits.

Source: Fernandez-Buhigas, I., Brik, M., Martin-Arias, A., Vargas-Terrones, M., Varillas, D., Baraket, R., & Santacruz, B. (2020). Maternal physiological changes at rest induced by exercise during pregnancy: A randomized controlled trial. *Physiology & Behavior, 220*, 112863. https://doi.org/10.1016/j.physbeh.2020.112863

Purpose/Sample	**Design (Method/Instruments)**	**Results**	**Strengths/Limitations**
Purpose: To study cardiovascular, metabolic, renal and hepatic changes in pregnant women as they correspond to the regular participation in a supervised exercise program. **Sample/Setting:** 92 women who met the following criteria: no OB complications, gestational age <16 weeks at time of recruitment, and not regularly exercising more than 30 min. 3 days per week. Hospital setting in Madrid, Spain. **Level of evidence:** 1 **Quality of evidence:** B	A randomly assigned intervention group (N=46) was chosen to participate in a mild-moderate supervised exercise program while a control group (N=46) continued with routine pregnancy care. BP, HR, weight, BGL, AST, ALT, blood creatinine, and uric acid were collected and differences between groups observed.	No differences were found in pregnancy weight, fasting glucose, aspartate-amino-transferase, alanine-amino-transferase, blood creatinine, or blood uric acid between intervention and control groups. Blood pressure was similar and systolic blood pressure was lower in control groups. **Conclusion:** Renal, metabolic, and hepatic metabolism was similar in both groups. Maternal BP was similar in both groups, although SBP was higher at 27-28 weeks in the intervention group. Pregnancy weight gain trended lower in the intervention group.	**Strengths:** RCT with multiple check-ins. The exercise guidelines were intentionally recommended. **Limitations:** Small sample size, high level of nulliparous women, inclusion of only low risk pregnancies.

Author Recommendations:
Regular supervised exercise during pregnancy does not alter normal maternal physiology.

Summary for current clinical practice question:
An exercise routine of mild-moderate intensity does not either negatively or positively affect physiological pregnancy outcomes.

Source: Ginar da Silva, S., Hallal, P. C., Domingues, M. R., Bertoldi, A. D., Freitas da Silveira, M., Bassani, D., Mohnsam da Silva, I. C., Cordeiro da Silva, B. G., de Vargas Nunes Coll, C., & Evenson, K. (2017). A randomized controlled trial of exercise during pregnancy on maternal and neonatal outcomes: Results from the PAMELA study. *International Journal of Behavioral Nutrition and Physical Activity, 14*(175). https://doi.org/10.1186/s12966-017-0632-6

Purpose/Sample	**Design (Method/Instruments)**	**Results**	**Strengths/Limitations**
Purpose: To study the usefulness of an exercise program on preventing negative maternal and newborn health outcomes. **Sample/Setting:** 639 healthy pregnant women. 213 in the intervention group. 426 in the control group. PAMELA (Physical Activity for Mothers Enrolled in Longitudinal Analysis) study, part of the 2015 Pelotas Birth Cohort Study **Level of evidence:** I **Quality of evidence:** A	An exercise-based intervention was carried out 3x/week for 16 weeks from 16-20 to 32-36 weeks' gestation. Primary outcomes measured were preterm birth and pre-eclampsia. Secondary outcomes were gestational weight gain, gestational diabetes, birth weight, infant length, and head circumference. Inclusion criteria were women 18 years or older residing in Pelotas, Rio Grande do Sul State, Brazil. Exclusion criteria were history of hypertension, cardiovascular disease, diabetes type 1 or 2, history of miscarriage or preterm birth, in vitro fertilization in the current pregnancy, current multiple gestation, persistent bleeding in the current pregnancy, BMI > 35 kg/m^2, or heavy smoker.	Mean gestational age and preterm birth did not vary between groups. This study showed no significant differences in the occurrence of GDM and preeclampsia ($p > 0.05$). intervention group women gained less weight than control group women. No statistical difference in mean birth weight ($p = 0.63$), length ($p = 0.33$), and head circumference ($p = 0.34$). **Conclusion:** This study didn't prove benefits of exercise on pregnancy for preventing preeclampsia or preterm birth; however, it did not demonstrate any adverse health outcomes on newborns either.	**Strengths:** RCT, carried out by certified professionals, intervention was planned in accordance with the ACOG recommendations. **Limitations:** A higher number of dropouts in the intervention group, nutritional intake was not followed, preeclampsia was evaluated by self-reporting, intervention timing overlapped with the usual onset of preeclampsia and preterm birth, and the sample population was very healthy resulting from strict eligibility criteria.

Author Recommendations:
This studies results should be interpreted with caution due to a lack of statistical power and low compliance.

Summary for current clinical practice question:
Indeterminate evidence for the effects of an exercise program and preterm birth and preeclampsia.

Source: Kasawara, K., Burgos, C. S. G., Lira do Nascimento, S., Ferreira, N.O., Surita, F. G., & Pinto e Silva, J.P. (2013). Maternal and perinatal outcomes of exercise in pregnant women with chronic hypertension and/or previous preeclampsia: A randomized controlled trial. *International Scholarly Research Notices, 2013.* https://doi.org/10.1155/2013/857047

Purpose/Sample	**Design (Method/Instruments)**	**Results**	**Strengths/Limitations**
Purpose: To study the relationship between a supervised exercise program and pregnant women with chronic hypertension or a history of preeclampsia on maternal and neonatal outcomes. **Sample/Setting:** 116 pregnant women with chronic hypertension and/or previous preeclampsia. Obstetrics Unit and in the Physical Therapy Unit at Outpatient Clinic of the Women's Hospital. **Level of evidence:** 1 **Quality of evidence:** A	Participants were randomly assigned to a study group or control group. Study group participants performed 30 minutes of supervised physical exercise on a stationary bike once a week beginning between 12-20 weeks' gestation until the end of pregnancy.	No differences were found between the 2 groups comparing type of delivery and maternal outcomes (maternal morbidity and hospitalization in intensive unit care) and neonatal outcomes, (birth weight, adequacy of weight to gestational age, prematurity, Apgar scale at first and fifth minutes, hospitalization in intensive unit care, and neonatal morbidity). **Conclusion:** This activity program did not produce maternal and neonatal risk.	**Strengths:** Randomization of participants **Limitations:** High cesarean section rates in both groups due to a large number of obese and repeat cesarean participants.

Author Recommendations:
Pregnant women with chronic hypertension or history of preeclampsia, including those who were previously sedentary, may initiate physical exercise with adequate supervision.

Summary for current clinical practice question:
Rest is the usual recommendation to prevent morbidity with hypertensive pregnant women. However, there is insufficient evidence to recommend regular rest as a method to prevent preeclampsia or complications from preeclampsia from developing.

Source: Melzer, K., Schutz, Y., Soehnchen, N., Othenin-Girard, V., Martinez de Tejada, B., Irion, O., Boulvain, M., & Kayser, B. (2010). Effects of recommended levels of physical activity on pregnancy outcomes. *American Journal of Obstetrics and Gynecology, 202*(3), e1-266-e6. https://doi.org/10.1016/j.ajog.2009.10.876

Purpose/Sample	**Design (Method/Instruments)**	**Results**	**Strengths/Limitations**
Purpose: To study the association between recommended levels of physical activity during pregnancy and pregnancy outcomes **Sample/Setting:** 44 healthy women between 35-41 weeks' gestation. University Hospitals of Geneva, Switzerland **Level of evidence:** III **Quality of evidence:** B	An observational study between 27 active and 17 inactive women was conducted to measure energy expenditure, aerobic fitness, and sleeping heart rate. Activity and energy expenditure were measured using 24-hour heart rate and movement recordings via a sensor worn on the chest.	Active women who performed 30+ minutes of moderate physical activity daily had markedly better fitness and lower sleeping heart rate compared to the inactive group. Second stage of labor was 88 min. in the active group and 146 min. in the inactive group, ($P = .05$). Operative delivery in the inactive vs the active was 3.7 (95% confidence interval, 0.87–16.08) odds ratio. Birthweight, maternal weight gain, and parity adjusted odds ratio was 7.6 (95% confidence interval, 1.23–45.8). **Conclusion:** 30 or more minutes per day of moderate physical activity was associated with improved cardiovascular fitness, showing no negative fetal effects or outcome of labor and delivery, and may decrease the length of the second stage of labor and the frequency of operative delivery.	**Strengths:** This is the first investigation using direct measurements rather than questionnaires when comparing the recommended activity levels on pregnancy outcomes. Subjects were representative of the general population rather than athletes. Activity levels were quantified in a natural living environment rather than a predetermined exercise program. **Limitations:** Observational study with a small number of participants.

Author Recommendations:
Additional studies with larger sample size are needed to confirm the positive correlation between physical activity and pregnancy outcome.

Summary for current clinical practice question:
It is safe for healthy pregnant women to follow ACOGs recommendation to participate in ≥30 minutes of moderate physical activity per day rather than rely on outdated advice to reduce physical activity.

Source: Montoya Arizabaleta, A., Orozco Buitrago, L., Aguilar de Plata, A., Mosquera Escudero, M., & Ramírez-Vélez, R. (2010). Aerobic exercise during pregnancy improves health-related quality of life: A randomized trial. *Journal of Physiotherapy, 56*(4), 253–258. https://doi.org/10.1016/s1836-9553(10)70008-4

Purpose/Sample	**Design (Method/Instruments)**	**Results**	**Strengths/Limitations**
Purpose: Physical activity during pregnancy is recommended, and may prevent maternal disorders, such as hypertension and gestational diabetes. **Sample/Setting:** Participants were recruited from prenatal care services in Cali, Colombia. Women who were interested in the study were invited to be screened. Sociodemographic data was recorded and a physical exam was performed to determine eligibility. After confirmation of eligibility, the women were randomly assigned to an aerobic exercise plus usual prenatal care group, or the usual prenatal care group only. **Level of evidence:** 1 **Quality of evidence:** B	A RCT with 64 nulliparous pregnant women attending prenatal care were evaluated. The experimental group completed a 3-month supervised exercise program beginning at 16-20 weeks. Each session included walking for 10 min., aerobic exercise for 30 min., stretching for 10 min., and relaxation for 10 min. The control group continued usual activities and performed no specific exercise.	Fifty women completed the study. CG = 26 and EG = 24. After the 3-month intervention, the experimental group had improved their health-related quality of life more than the control group. **Conclusion:** Aerobic exercise during pregnancy improved health-related quality of life.	**Strengths:** High compliance with the trial was a major strength. **Limitations:** The small sample size of this RCT.

Author Recommendations: Exercise improves physical and psychological function in healthy people. The effects of exercise during pregnancy should be analyzed. Exercise can be prescribed during pregnancy and is expected to improve the quality of life.

Summary for current clinical practice question:
Exercise during pregnancy improves the overall health-related quality of life and should be recommended for all eligible pregnant women.

Source: Petrov Fieril, K., Glantz, A., & Fagevik Olsen, M. (2015). The efficacy of moderate-to-vigorous resistance exercise during pregnancy: A randomized controlled trial. *Acta Obstetricia et Gynecologica Scandinavica*, *94*(1), 35–42. https://doi.org/10.1111/aogs.12525

Purpose/Sample	**Design (Method/Instruments)**	**Results**	**Strengths/Limitations**
Purpose: This RCT was done to assess the effects and safety of moderate to vigorous resistance exercise during pregnancy. **Sample/Setting:** Pregnant women in Gothenburg, Sweden from two antenatal clinics were assessed for the RCT. 92 healthy pregnant women were studied. **Level of evidence:** 1 **Quality of evidence:** B	The supervised group was the intervention group. They received supervised resistance exercise twice a week. The exercises were done within moderate to vigorous intensity. N = 51. The intervention was administered during gestational weeks 14-25. The control group received generalized exercise recommendations, a home-based training program, and telephone follow up. N = 41	No significant differences were found between the groups. They both showed a normal health-related quality of life. They also both had normal blood pressure and perinatal data. **Conclusion:** Resistance exercise does not jeopardize the health and wellbeing of pregnant women or their fetus during pregnancy. It is an appropriate form of exercise in a healthy pregnancy.	**Strengths:** Only a few RCTs have studied resistance training during pregnancy. This study supports the finding that higher intensity resistance training is appropriate and safe during pregnancy. **Limitations:** The smaller size of this RCT is a limitation, and they also had several women dropout. Another limitation is that both groups were physically active at baseline. This could explain why no significant differences were found between the groups.

Author Recommendations:
Moderate to vigorous resistance exercise appears to be an appropriate form of exercise for healthy pregnant women.

Summary for current clinical practice question:
Maintaining a physically active lifestyle has many health benefits. Exercise should be continued throughout pregnancy.

Source: Robledo-Colonia, A. F., Sandoval-Restrepo, N., Mosquera-Valderrama, Y. F., Escobar-Hurtado, C., & Ramírez-Vélez, R. (2012). Aerobic exercise training during pregnancy reduces depressive symptoms in nulliparous women: A randomized trial. *Journal of Physiotherapy*, *58*(1), 9–15. https://doi.org/10.1016/S1836-9553(12)70067-X

Purpose/Sample	**Design (Method/Instruments)**	**Results**	**Strengths/Limitations**
Purpose: The purpose of this study was to see if supervised aerobic exercise during pregnancy reduces depressive symptoms in nulliparous women. **Sample/Setting:** 80 nulliparous pregnant women who were attending prenatal care at a tertiary hospital in Cali, Columbia were studied. Women were recruited from their prenatal care providers **Level of evidence:** 1 **Quality of evidence:** B	A RCT was conducted. After confirmation of eligibility, the women were randomly allocated to the exercise and usual prenatal care group, or the usual prenatal care only group. The experimental group (EG) (N = 40) completed a 3-month supervised exercise program beginning between 16-20 weeks' gestation. The sessions were 3x a week, and included walking, aerobic exercise, stretching, and relaxation. The control group (CG) (N = 40) performed no specific exercise and continued their usual activities. Baseline measures on the Center for Epidemiological Studies Depression Scale (CES-D) were taken the day before the exercise program started, and outcomes were measured the day after the program was completed.	74 women completed the study. After the 3-month intervention, the EG reduced their depressive symptoms on the CSE-D questionnaire by 4 points more than the CG. No adverse events occurred during or after the exercise. **Conclusion:** Physiotherapists should advise pregnant women that aerobic exercise training during pregnancy reduces the severity of symptoms of depression.	**Strengths:** This study had concealed allocation, and it was also done with an intention to treat analysis. Only one outcome was measured so the risk of Type I error was low. **Limitations:** The therapists and participants were not blinded. Further studies may be needed to explore the relationships among psychological status, physical function, and quality of life during pregnancy with depressive symptoms. There was also a small number of participants.

Author Recommendations: Aerobic exercise should be prescribed during pregnancy for its range of benefits, including its positive effect on reducing the severity of any depressive symptoms.

Summary for current clinical practice question:
Depression during pregnancy is associated with an increased risk of prenatal and perinatal complications. Physical activity during pregnancy positively effects both mother and baby, and is an effective therapy for depression.

Source: Rodríguez-Blanque, R., Sanchez-Garcia, J., Sanchez-Lopez, A., Expósito-Ruiz, M., & Aguilar-Cordero, M. (2019). Randomized clinical trial of an aquatic physical exercise program during pregnancy. *Journal of Obstetric, Gynecologic, and Neonatal Nursing*, *48*(3), 321–331. https://doi.org/10.1016/j.jogn.2019.02.003

Purpose/Sample	**Design (Method/Instruments)**	**Results**	**Strengths/Limitations**
Purpose: This study was done to determine the effect of an aquatic physical exercise program performed during pregnancy on the rate of intact perineum after birth. **Sample/Setting:** Health centers in the metropolitan health district of Granada, Spain. **Level of evidence:** 1 **Quality of evidence:** B	RCT with a total of 129 pregnant women. Control Group (CG) N = 64. Aquatic exercise group (EG) N = 65. The intervention was an aquatic physical exercise program designed specifically for pregnant women. Participants were randomly assigned to the CG or the EG. Women in the EG performed three sessions per week of aquatic physical exercise. All women received routine prenatal care.	The women in the exercise group had a greater rate of intact perineum compared to the women in the control group. Maternal weight gain did not affect the odds for intact perineum. Women who received anesthesia and who had previous pregnancies were also associated with intact perineum. **Conclusion:** Women who participated in aquatic exercise during pregnancy were significantly more likely to have intact perineum after birth.	**Strengths:** High adherence to the study with positive results. **Limitations:** This was a small RCT.

Author Recommendations:
Women should be educated on the positive effects of exercise in pregnancy, and specifically on the benefits of aquatic physical exercise.

Summary for current clinical practice question:
Women who suffer from an extensive perineal tear have higher rates of morbidity. Water exercise during pregnancy is shown to reduce this risk, and help women have intact perineum after childbirth.

Source: Ronnberg, A. K., Ostlund, I., Fadl, H., Gottvall, T., & Nilsson, K. (2015). Intervention during pregnancy to reduce excessive gestational weight gain: A randomized controlled trial. *BJOG: An International Journal of Obstetrics and Gynaecology*, *122*(4), 537–544. https://doi.org/10.1111/1471-0528.13131

Purpose/Sample	**Design (Method/Instruments)**	**Results**	**Strengths/Limitations**
Purpose: To evaluate if feasible, low-cost interventions could decrease the number of women gaining weight above standard recommendations compared with standard maternity care. **Sample/Setting:** 14 antenatal clinics in Sweden participated. Healthy women who were greater than 16 weeks' gestation, with a BMI above 19, who were at least 18 years old were invited to participate. **Level of evidence:** 1 **Quality of evidence:** A	A RCT was used. 445 women were randomized, and 374 women remained in the study. The standard care group (N = 182) received the standard 3 prenatal visits, and were given guidelines on pregnancy dietary intake. They were compared to an intervention group (N = 192) consisting of education on recommended weight gain, application of personalized weight graph, a formalized prescription of exercise, and regular monitoring of weight gain at every prenatal visit. The exercise that was prescribed was a recommendation of physical activity at a moderate level of exertion for approximately 30 minutes per day.	Gestation weight gain was significantly lower in the intervention group. **Conclusion:** The low-cost intervention program did significantly reduce gestation weight gain.	**Strengths:** The large sample size and randomized design were strengths of the study. Excluding underweight women, there was no discrimination of pre-pregnancy BMI. **Limitations:** There was an 8% loss in the intervention group, and an 11% loss in the standard care group.

Author Recommendations:
The mode of intervention is feasible, and can be readily applied in existing maternal healthcare settings.

Summary for current clinical practice question:
Regular exercise and education on recommended gestational weight gain helps women gain less weight during pregnancy.

Source: Ruchat, S., Davenport, M., Giroux, I., Hillier, M., Batada, A., Sopper, M., Hammond, J., & Mottola, M. (2012). Nutrition and exercise reduce excessive weight gain in normal-weight pregnant women. *Medicine and Science in Sports and Exercise*, *44*(8), 1419–1426. https://doi.org/10.1249/MSS.0b013e31825365f1

Purpose/Sample	Design (Method/Instruments)	Results	Strengths/Limitations
Purpose: This study evaluated the effects of an exercise program with nutritional control during pregnancy. **Sample/Setting:** Normal weight pregnant women were recruited through referrals from medical professionals when they were between 16-20 weeks' gestation in Canada. Before being enrolled, they were medically screened. **Level of evidence:** 1 **Quality of evidence:** B	Pregnant women with a normal pre-pregnancy BMI were randomized to either a low-intensity (N = 23) or moderate-intensity (N = 26) exercise program, with nutritional control. The exercise programs consisted of walking sessions 3-4x a week, increasing time from 25-40 min. per session. 45 pregnant women, also with normal pre-pregnancy BMI, did not participate in any structured exercise group (CG).	Women in the CG had higher gestational weight gain compared to the women in the exercise groups. Excessive gestational weight gain in the low-intensity group was prevented in 70% of the women, and 77% in the moderate-intensity group. **Conclusion:** Prenatal nutrition and exercise programs reduce excessive gestational weight gain regardless of intensity.	**Strengths:** The combination of a supervised exercise program with nutrition control, the randomization of the participants in two exercise intensities, weekly weight gains, and follow-up at 2 months postpartum were all strengths of this RCT. **Limitations:** This was a small RCT, and the women in the CG did not differ from those in the intervention groups. They were all similar pre-pregnancy BMI, age, and parity. These are all factors that may influence gestation weight gain.

Author Recommendations: Exercise, regardless of intensity, should be recommended to all eligible, pregnant women. They should also be advised on a healthy, nutritional program throughout their pregnancy. Healthy lifestyle habits and weight gain recommendations should be recommended to women as soon as they are thinking of becoming pregnant.

Summary for current clinical practice question: Over half (52%) of the women who did not exercise during their pregnancies gained over the recommended gestational weight gain. Excessive weight gain can lead to higher morbidity complications.

Source: Szymanski, L., & Stain, A. (2012). Strenuous exercise during pregnancy: Is there a limit? *American Journal of Obstetrics & Gynecology, 207*(3), 179. https://doi.org/10.1016/j.ajog.2012.07.021

Purpose/Sample	**Design (Method/Instruments)**	**Results**	**Strengths/Limitations**
Purpose: To evaluate how vigorous exercise effects fetal response in physically active and sedentary women. **Sample/Setting:** 45 women, 15 non-exercisers, 15 regularly active and 15 highly active **Level of evidence:** III **Quality of evidence:** B	Subjects participated in a treadmill test until volitional fatigue was reached at 28 weeks-32 weeks 6 days' gestation. Umbilical artery Doppler indices, fetal heart tracing/rate, uterine artery doppler scans, and biophysical profiles were evaluated before and after exercise.	Umbilical and uterine artery Doppler indices were comparable among both activity groups. They did not change with exercise ($p > .05$). BPP and fetal heart tracings were reassuring in all groups. In 5 of the highly active women, there were transient fetal heart rate decelerations and elevated umbilical and uterine artery Doppler indices after exercise. Afterwards, BPP and fetal heart tracings were reassuring. **Conclusion:** Fetal well-being is reassuring after a short-duration of vigorous exercise in both active and sedentary pregnant women.	**Strengths:** A variation of fetal well-being tests were completed. Both exercisers and non-exercisers were studied. **Limitations:** Fetal well-being was not evaluated during exercise. Participants were all healthy women of normal weight before pregnancy.

Author Recommendations:
Additional research is needed on exercise in pregnant athletes to determine whether an upper limit of exercise exists that would place a fetus at risk if a threshold is crossed. Pregnant athletes may benefit from individualized exercise programs because they may exceed a point at which markers of fetal well-being may be compromised.

Summary for current clinical practice question:
It is unclear how strenuous physical activity affects a fetus and if there is a point at which fetal well-being is compromised.

Source: Wang, C., Wei, Y., Zhang, X., Zhang, Y., Xu, Q., Sun, Y., Su, S., Zhang, L., Liu, C., Feng, Y., Shou, C., Guelfi, K. J., Newnham, J. P., & Yang, H. (2017). A randomized clinical trial of exercise during pregnancy to prevent gestational diabetes mellitus and improve pregnancy outcome in overweight and obese pregnant women. *American Journal of Obstetrics & Gynecology, 217*(4), 340-351. https://doi.org/10.1016/j.ajog.2017.01.037

Purpose/Sample	**Design (Method/Instruments)**	**Results**	**Strengths/Limitations**
Purpose: To test the efficacy of regular exercise in early pregnancy to prevent GDM in overweight/obese pregnant women. **Sample/Setting:** Sample: nonsmoking women age >18 years with a singleton pregnancy who had BMI 24≤28 and had an uncomplicated pregnancy at <12 weeks of gestation. 300 women were initially recruited with 265 completing the testing for GDM. Setting: a prenatal care class specifically for women in early pregnancy at the Department of OB/GYN Peking University First Hospital. **Level of evidence:** 1 **Quality of evidence:** A	Patients assigned to the exercise group were instructed to exercise 3 times per week (at least 30 min./session with a rating of perceived exertion between 12-14) via a cycling program begun within 3 days of randomization until 37 weeks of gestation. Those in the control group continued their usual daily activities. Both groups received standard prenatal care, albeit without special dietary recommendations. The primary outcome was incidence of gestational diabetes mellitus. Instrument: cycling program	22% incidence of GDM in the exercise group vs. 40.6% in the control group. 95% confidence interval. 45.8% reduction in GDM. **Conclusion:** Cycling exercise initiated early in pregnancy and performed at least 30 minutes, 3 times per week, is associated with a significant reduction in the frequency of gestational diabetes mellitus in overweight/obese pregnant women. There was no evidence that the exercise prescribed in this study increased the risk of preterm birth or reduced the mean gestational age at birth.	**Strengths:** The supervised cycling exercise intervention used ensured the appropriate amount and intensity of exercise and high adherence to the intervention program The intervention did not include a dietary component, which facilitated the ability to discern the effect of exercise itself on outcomes. **Limitations:** Lacking a dietary element limited researchers from analyzing and comparing the combined effect of exercise and dietary interventions. Not practical to introduce this type of a supervised activity program for pregnant women on a grander scale .

Author Recommendations:
In the absence of contraindications, regular exercise should be recommended as an important part of antenatal care.

Summary for current clinical practice question:
In women who are overweight or obese before pregnancy and seeking ways to decrease their risk of GDM and other adverse pregnancy outcomes, exercise is a feasible plan.

<table>
<tr><td colspan="4">Source: Ward-Ritacco, C., Poudevigne, M., & O'Connor, P. (2016). Muscle strengthening exercises during pregnancy are associated with increased energy and reduced fatigue. Journal of Psychosomatic Obstetrics & Gynecology, 37(2), 68-72. https://doi.org/10.3109/0167482X.2016.1155552</td></tr>
<tr><td>Purpose/Sample</td><td>Design (Method/Instruments)</td><td>Results</td><td>Strengths/Limitations</td></tr>
<tr><td>Purpose:

To determine if muscle strengthening exercises during pregnancy are associated with increased energy and reduced fatigue.

Sample/Setting:

Sample: 26 women, between 17 and 38 years, between 21 and 25 weeks' gestation and with back pain or a history of back pain. 6 were excluded from the final analysis

Setting:
Center for Physical Activity and Health

Level of evidence:
II
Quality of evidence:
B</td><td>Twenty-six women performed six low-to-moderate intensity resistance exercises twice per week from 23 to 35 weeks' gestation and measurements were made before and after each workout using the Mental and Physical State Energy and Fatigue Scales.

Instrument: low-to-moderate intensity strength training.</td><td>Resistance exercises increased physical and mental energy 92-96% of workouts and decreased physical and mental fatigue in 79-88% of workouts.

Conclusion:

The majority of a small group of generally healthy pregnant women (77%), on average across 24 workouts, reported increased feelings of energy and reduced feelings of fatigue after a single bout of low-to-moderate intensity muscle strengthening exercise.</td><td>Strengths:

The documentation of the repeatability across 12 weeks of the positive psychological changes after acute bouts of resistance exercise.

Limitations:

A non-exercise control group was not included in the present study. Therefore, alternative explanations for the findings cannot be excluded.

The participants self-selected in response to advertising and were not randomly selected from a defined population. Therefore, it is not known how these findings compare to other groups of pregnant women.

Small sample size.</td></tr>
<tr><td colspan="4">Author Recommendations:
Acute, low-to-moderate intensity muscle strengthening exercise during pregnancy is effective for transiently improving feelings of energy and fatigue.</td></tr>
<tr><td colspan="4">Summary for current clinical practice question:
Fatigue and low energy during pregnancy are common concerns that are often inadequately managed by pregnant women and their health care providers. Acute bouts of resistance exercise are consistently associated with increases in feelings of energy and decreases in feelings of fatigue in pregnant women during the second and third trimesters.</td></tr>
</table>

Source: Watson, S., Lewis, A., Boyce, P., & Galbally, M. (2018). Exercise frequency and maternal mental health: Parallel process modelling across the perinatal period in an Australian pregnancy cohort. *Journal of Psychosomatic Research, 111*, 91-99. https://doi.org/10.1016/j.jpsychores.2018.05.013

Purpose/Sample	**Design (Method/Instruments)**	**Results**	**Strengths/Limitations**
Purpose: To examine the relationship between exercise and maternal mental health symptoms during the perinatal period. **Sample/Setting:** 258 women from the Mercy Pregnancy and Emotional Wellbeing Study, an Australian pregnancy cohort. **Level of evidence:** II **Quality of evidence:** A/B	The sample was assessed for depression using the Edinburgh Postnatal Depression Scale (EPDS), anxiety using the State Trait Anxiety Inventory (STAI) and a diagnostic interview, and self-reported use of antidepressants during the 1st and 3rd trimesters of pregnancy and at 6 and 12 months postpartum. Exercise was measured by self-reporting with a weekly frequency of 30 min. bouts of moderate to vigorous exercise. Women were divided into 3 groups: women taking antidepressants, non-medicated women who met the criteria for a diagnosis of Major Depressive Disorder, and a control group who did not meet the diagnosis and was not taking antidepressants.	During the first trimester, the control group reported significantly more frequent weekly exercise compared to women taking antidepressants, exercise frequency did not differ compared to non-medicated depressed women. There was no difference in frequency during the other 3 check points. Women who reported more rapid reductions in their exercise frequency during the perinatal period reported increasing symptoms of depression and anxiety. **Conclusion:** Maintaining levels of early pregnancy exercise throughout the pregnancy and postpartum period shows a potential benefit for depressive and anxious symptoms.	**Strengths:** This is the first study to report repeat measurement of both exercise and depression across the perinatal period and to include a diagnostic measure of depression and a group treated with antidepressant medication. **Limitations:** A small non-medicated depressed group of women (28). The range of EPDS and STAI scores and linear change estimates are limited due to greater proportion of healthy controls in the sample.

Author Recommendations:
There are potential benefits for depressive and anxious symptoms when maintaining levels of early-pregnancy exercise throughout pregnancy and the postpartum.

Summary for current clinical practice question:
There is a positive correlation between exercise and mental health during pregnancy and especially for women previously diagnosed with depression.