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# **Regular Exercise Throughout Pregnancy and Maternal Recovery Postpartum**

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## Abstract

**Introduction:** The American College of Obstetricians and Gynecologists recommends that “women with uncomplicated pregnancies should be encouraged to engage in aerobic and strength-conditioning exercises before, during, and after pregnancy.”<sup>1</sup> Many pregnant mothers seek guidance regarding exercise regimens’ safety and efficacy. This paper is a systematic review of the current literature on the topic of exercise regimens performed throughout pregnancy and maternal postpartum recovery.

**Purpose:** To determine if following the American College of Obstetricians and Gynecologists recommendation to engage in regular aerobic and strength-conditioning exercises throughout pregnancy contributes to easier deliveries as measured by the number of caesarean sections, time spent in labor, and time needed for maternal recovery postpartum when compared to mothers who do not participate in exercise regimens.

**Methods:** Databases including Ovid and Pubmed were utilized to identify peer-reviewed articles that met inclusion criteria. The quantitative and qualitative results from these articles were compiled and synthesized. Articles screened were included or excluded based on inclusion and exclusion criteria initially, followed by a more thorough assessment of the abstract and finally of the full text articles. Articles providing support for and evidence against different exercise regimens during pregnancy and their effects on maternal postpartum recovery are included in the synthesis.

**Results:** Outcomes measured by the articles reviewed included type of delivery, requests for analgesia, pregnancy weight gain, length of labor, self-reported postpartum recovery, and hospitalization during pregnancy. Statistically significant findings were reported for exercise relating to less pregnancy related weight-gain, a decrease in the number of caesarean deliveries, a decrease in the number of requests for analgesia, and decrease in maternal recovery time postpartum.

**Discussion:** These findings provide better evidence with which to encourage pregnant mothers to exercise even when they have not participated in exercise regimens before. Limitations of this study and the articles analyzed include the following: articles often reported statistically significant data on one or more topics regarding maternal recovery postpartum, but often the articles did not agree. Many articles did not measure the same variables and few found similar conclusions.

**Conclusion:** There is evidence for utilizing a structured exercise regimen throughout pregnancy to decrease pregnancy related weight-gain, to decrease risk of caesarean section, to decrease the need for anesthesia during labor and delivery, and to decrease maternal recovery time postpartum. More research needs to be done to strengthen the evidence for encouraging regular exercise in pregnant women to decrease these risks and to establish statistical significance for other measures of maternal postpartum recovery. Studies should be reproduced on a larger scale in order to achieve statistical significance and allow for better clinical evidence to be utilized by providers and taught to patients.

## **Introduction**

Since pregnancy brings with it numerous physiologic changes to a mother and baby, many mothers, especially new mothers, wonder what benefits they might gain from exercise throughout pregnancy and how physical activity done throughout their pregnancy might affect the health of their baby or babies.<sup>7</sup> Because of this worry and to determine effects of exercise during pregnancy on mothers and babies, physical activity throughout pregnancy and its effects is a current topic of conversation in both medical and athletic literature.

Current epidemics throughout the world in overweight and obesity bring about some hypotheses regarding beneficial results from exercise throughout pregnancy. Kader and Naim-Shuchana propose that because excess weight during pregnancy is associated with elevated risks of serious complications for both the mother and the baby during pregnancy and childbirth, exercise to ward off excessive weight gain in pregnancy could help avoid difficult deliveries and long recovery times post partum.<sup>7, 10</sup> Some of the adverse obstetric and neonatal outcomes of overweight and obese mothers include diabetes and its complications, preterm birth, cesarean section, post partum hemorrhage, macrosomia, or low birth weight in varying ethnic and racial groups.<sup>7, 10</sup> A recent systematic review of the current literature written by Kader and Naim-Shuchana did not find a connection between exercise performed throughout pregnancy and an increased risk of premature birth or any other adverse pregnancy or childbirth outcomes.<sup>7</sup> This same article concludes that “physical activity and exercise during pregnancy does not increase any risk of adverse pregnancy or birth outcomes, not even for elite athlete women.”<sup>7</sup> This is a significant finding and has clinical relevance because this knowledge can help women who worry about potential adverse effects of exercise on their baby to know that evidence-based medicine and research support their choice to be active during pregnancy. Some positive effects

of physical activity and exercise performed throughout pregnancy are outlined in this systematic review and include: general fitness and well-being, pelvic floor muscle strengthening (that has been shown to help prevent urinary and anal incontinence postpartum), a possibility of the reduction in the incidence of premature births, and better fetal blood flow leading to better fetal growth.<sup>7</sup>

In light of the current interest in exercise to maximize benefits and avoid harm during pregnancy and delivery, The American College of Obstetricians and Gynecologists has developed evidence-based guidelines for pregnant women to follow when organizing an exercise regimen to follow throughout their pregnancy.<sup>5</sup> Since these guidelines have been released, studies have been done and articles written on the effects of following them for both the mother and the baby. This paper is a systematic review of the current literature on this topic that seeks to answer the following question: Does following the American College of Obstetricians and Gynecologists recommendation to engage in regular aerobic and strength-conditioning exercises throughout pregnancy contribute to easier deliveries as measured by the number of cesarean sections, time spent in labor, and time needed for maternal recovery postpartum when compared to mothers who do not participate in exercise regimens?

Population (P): Pregnant women

Intervention (I): Regular aerobic and strength-conditioning exercise throughout pregnancy

Comparison (C): Inactivity throughout pregnancy

Outcome (O): Type of delivery, ease of delivery, maternal recovery postpartum

## **Methods**

### **Search Strategy and Selection Criteria**

Search terms used to find articles to analyze in the results section were: “pregnancy”; “exercise regimen”; “delivery”; “postpartum recovery”, and “cesarean section.” The search databases used were Ovid and Pubmed.

Inclusion criteria for articles include the following: the article was in English; the article was written in or after 2006, the article was peer reviewed, and the article was an original research study or a meta-analysis of original study.

Exclusion criteria for articles included the following: no article written before 2006, no article that was not written in English was used, and no article that was not peer reviewed was used.

Articles screened were included or excluded based on inclusion and exclusion criteria initially followed by a more thorough assessment of the abstract and finally of the full text. Articles providing support for and evidence against the exercise regimen during pregnancy are included in the following section.

The quantitative and qualitative results from these articles were compiled and synthesized. Articles screened were included or excluded based on inclusion and exclusion criteria initially, followed by a more thorough assessment of the abstract and finally of the full text articles. Articles providing support for and evidence against different exercise regimens during pregnancy and their effects on maternal postpartum recovery are included in the synthesis.

**Table 1: Methods in Brief**

<b>Keywords</b>	Pregnancy, exercise regimen, delivery, postpartum recovery, cesarean section
<b>Databases</b>	Ovid & Pubmed
<b>Inclusion Criteria</b>	English language Written in or after 2006 Peer-reviewed Review or Original research study
<b>Exclusion Criteria</b>	Not written in the English language Written before 2006 Not peer-reviewed

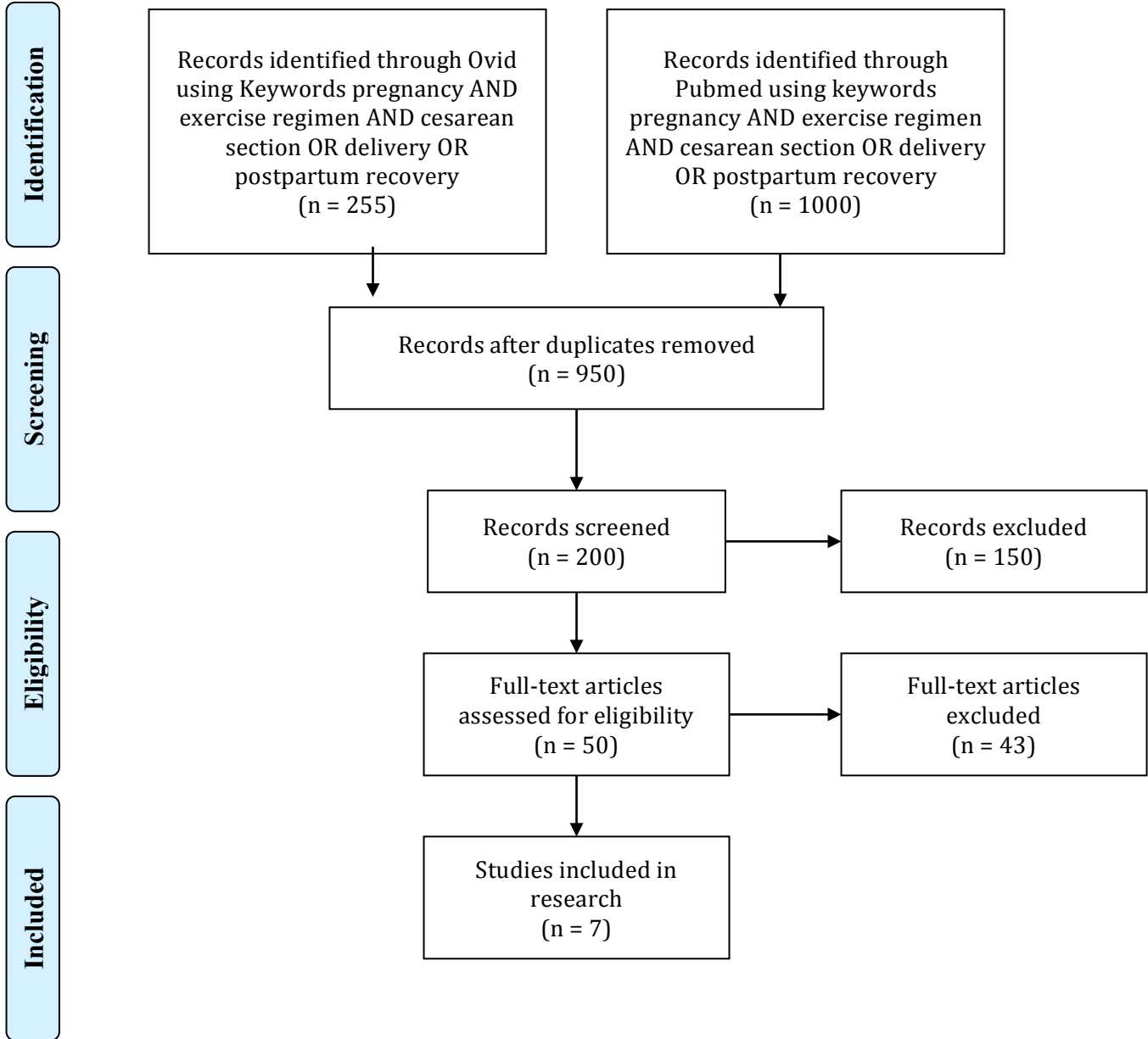
The consort diagram below demonstrates the process of identifying articles that met inclusion criteria.



Figure 1: Consort Diagram



PRISMA Flow Diagram



## **Results**

### **Literature Search Results**

Results from the literature search show that studies on this topic vary widely in terms of the number of participants, type of exercise regimen and especially in outcomes measured. This systematic review analyzes several randomized control trials, meta-analyses, retrospective and prospective cohort studies and non-randomized experimental studies. Comparison of study designs is outlined in Table 2.

Study	Study Design	Total Number of Participants	Population Characteristics	Type of Exercise Regimen	Outcomes measured
Baciuk et al.	RCT	71	One fetus, no gestational risks	Water aerobics	VO2 Max, CO, Skin T, Length of Labor, Type of Delivery, Requests for Analgesia, Neonatal Health
Barakat et al.	RCT	320	One fetus, no gestational risks, Spanish-speaking Caucasians	Aerobic Exercise for 1hr 3x/week	HR during exercise, preterm birth, Fetal APGAR score, Birth weight & length, pH umbilical cord blood
Bungum et al.	Retrospective Cohort	137	One fetus, non-smoking aged 17-40	Aerobic Exercise in the first two trimesters	Activity level, Method of Delivery
Domenjoz et al.	Meta-analysis of RCTs	NA	One fetus without absolute obstetrics contraindications to exercise	Various	Pregnancy weight gain, C-section incidence, Instrumental delivery, episiotomy, epidural, perineal tear, length of labor, induction of labor, infant birth weight & APGAR Score
Price et al.	Prospective RCT	62	No exercise regimen in place prior to pregnancy	Aerobic Fitness Regimen based on 2002 ACOG Guidelines	C-section incidence, Infant size, Postpartum recovery
Salvesen et al.	Experimental	6	Elite Endurance Athletes	Strenuous Treadmill Running	Uteroplacental blood flow during exercise
Tinloy et al.	Retrospective Cohort	3006	Participants in the "First Baby Study"	At least 150 min of exercise per week during pregnancy	Preterm birth, C-section incidence, Hospitalization during pregnancy

Key: RCT=Randomized Controlled Trial; ACOG=American College of Obstetricians and Gynecologists; CO=Cardiac Output; HR=Heart Rate; T=Temperature

Table 3 shows the validity assessment of the articles included in this review. Validity of the exercise regimen timelines, methods of follow up, patient accounting, intention to treat, and power are included in the table. Exercise regimens were considered adequate if they lasted greater than 20 weeks. Methods of follow up were considered adequate if a significant number of participants were able to follow up. Methods of patient accounting were considered adequate if they were able to appropriately measure the outcomes outlined in the methods section of the papers. Intention to treat analysis was considered adequate if the study analyzed all participants allocated to groups whether or not they followed the intended protocols. Power was considered adequate if sample sizes were large enough to achieve statistical significance. Most articles showed adequate exercise regimen timelines, methods of follow up, patient accounting, and power. Intention to treat analysis was adequate for only the Price article.

Table 3. Validity Assessment					
Study	Adequate Exercise Regimen Timeline (>20 weeks)	Method of Follow Up	Patient Accounting	Intention to Treat Analysis	Power Adequate
Baciuk et al.	A	A	A	I	A
Barakat et al.	A	A	A	I	A
Bungum et al.	A	M	M	I	A
Domenjoz et al.	I	I	I	I	A
Price et al.	A	A	A	A	A
Salvesen et al.	I	A	A	I	M
Tinloy et al.	I	A	A	I	I

Key: A=adequate, M=marginal, I=Inadequate evidence

## **Literature Review Results**

Three main themes emerged from the study of exercise regimens and maternal recovery post partum. Women who participated in the exercise regimens were less likely to 1) need a cesarean delivery, 2) request analgesia during labor, and 3) gain excessive weight in pregnancy. Other articles found that mothers participating in the exercise regimens also benefited from decreased recovery time postpartum, reduced incidence of hypertension during pregnancy, and improved aerobic fitness and muscular strength.<sup>11</sup> Price et al. found that even inactive women who began their exercise regimens at 12-14 weeks of gestation improved both delivery and recovery outcomes.<sup>11</sup> Negative effects from exercise programs on the newborns occurred only in one study when Olympic level athlete mothers reached 90% of their maximum heart rate.<sup>12</sup> At this point blood flow to the developing fetus was diminished.<sup>12</sup> When exercise over 90% of maximum heart rate ceased, however, the blood flow to the fetus returned to baseline and no lasting damage to the newborns was noted.<sup>12</sup> Uterine blood volume was reduced during submaximal exercise on the treadmill, but it was not reduced enough to cause harm until the mother reached more than 90% of maximal heart rate.<sup>12</sup> When this occurred, fetal bradycardia and high umbilical artery pulsatility index occurred.<sup>12</sup> Uterine artery blood flow became less than 50% of at rest.<sup>12</sup> These numbers normalized quickly, however, upon maternal rest.<sup>12</sup> This article shows that mothers can continue to train as long as they and their babies are closely monitored.<sup>12</sup>

### **Decrease in the Need for a Cesarean Delivery**

Articles by Bungum et al., Domenjoz et al., and Tinloy et al. found statistically significant results related to exercise and cesarean delivery. Bungum et al. aimed to determine potential associations between aerobic exercise in the first two trimesters of pregnancy and the

type of delivery in women who have never given birth before. This study established a correlation between the two.<sup>3</sup> Results from the Domenjoz article also found that exercise regimens followed throughout the course of pregnancy led to fewer cesarean deliveries but this article showed statistically significant results.<sup>6</sup> Price et al. used a specific exercise regimen from the 2002 American College of Obstetricians and Gynecologists guidelines for exercise during pregnancy.<sup>11</sup> Results from this research indicated fewer cesarean deliveries in women that exercised.<sup>11</sup> Tinloy et al. studied whether regular exercise regimens followed throughout gestation was associated with preterm birth, cesarean deliveries, and hospitalizations during gestation. 3006 women in their third trimester of pregnancy were interviewed and reported weekly exercise as a part of this study.<sup>13</sup> Potentially confounding factors such as age, race, marital status, education level, poverty level, BMI, gestational weight gain, diabetes, and hypertension were controlled for.<sup>13</sup> Regular exercise was considered at least 150 minutes of exercise per week.<sup>13</sup> Using multivariable analysis, the study found that regular exercise during gestation was not related to preterm birth or hospitalizations during pregnancy but was associated with reduced odds of cesarean delivery (though this finding was not statistically significant) when compared with women who exercised less than 60 minutes per week.<sup>13</sup>

### **Decrease in Requests for Analgesia during Labor**

Baciuk et al. study included VO<sub>2</sub> max, cardiac output, and skin temperature data.<sup>1</sup> Data on labor, delivery and neonatal outcomes was collected.<sup>1</sup> This study design was appropriate because randomized control trials are the best for determining if there is a causal relationship between two factors. No difference was found between the two groups in regard to duration or type of delivery.<sup>1</sup> A positive finding, however, was found in regards to requests for analgesia.<sup>1</sup>

Women in the water aerobics group requested analgesia for labor significantly less than women in the control group (25% versus 65%).<sup>1</sup> The statistics show a statistically significant difference between groups that request analgesics.<sup>1</sup> A 58% reduction in the risk of requesting analgesia was seen.<sup>1</sup> The relative risk of 0.42 found shows a protective effect of the water aerobics.<sup>1</sup> A 95% confidence interval between 0.23-0.77 was found.<sup>1</sup> This statistical significance remained even when controlling for parity and level of schooling.<sup>1</sup> The babies experienced similar outcomes in both groups.<sup>1</sup> This indicates that stronger bodies and greater cardiovascular endurance helped the women in the water aerobics group to physically handle labor and delivery better.

### **Decrease in Excessive Weight Gain in Pregnancy**

Domenjoz et al. found that women following exercise regimens gained significantly less weight than those not following exercise regimens and there was no significant reduction in birth weight of infants born to the exercising mothers.<sup>6</sup> Women following exercise regimens gained significantly less weight than those not following exercise regimens (with a mean difference of 1.13 kg (95% CI).<sup>6</sup> There was no significant reduction in the birth weights of infants born to the exercising mothers.<sup>6</sup> The data drawn from the studies analyzed by this study justify the conclusions that exercise during pregnancy helps with postpartum recovery in that the women have less excess weight to lose and are less likely to have a cesarean section delivery.

### **Additional Findings**

Price et al. found that active women had reduced incidence of hypertension during pregnancy and experienced improved aerobic fitness and muscular strength. The study of the size of infants at birth was not found to be statistically significant.<sup>11</sup> Barakat et al. aimed to “examine

the influence of an aerobic exercise program throughout pregnancy on gestational age at the moment of delivery.”<sup>2</sup> The researchers measured the incidence of preterm birth.<sup>2</sup> This study employed a randomized control trial to determine if exercise during pregnancy could lead to preterm delivery.<sup>2</sup> The study did not find a correlation between exercise and preterm birth.<sup>2</sup> No differences were found in regards to health and APGAR scores at 1 minute and 5 minutes of life either.<sup>2</sup> No differences in birth weight percentage were found – birth weight, birth length, and the pH of umbilical cord blood were all similar.<sup>2</sup> Moderate exercise during pregnancy, beneficial for many reasons, was also found not to be harmful to the fetus in this study.<sup>2</sup> This study concluded: “a supervised program of moderate exercise performed throughout pregnancy is not a risk of preterm delivery for healthy pregnant women.”<sup>2</sup> The lack of statistically significant differences between the exercise and the control group support this conclusion. Domenjoz et al. evaluated other risk factors evaluated such as APGAR score, episiotomy, epidural anesthesia, perineal tear, length of labor, and induction of labor did not produce results that were significant enough to draw conclusions from.<sup>6</sup>

Table 4 summarizes the above results.



Study	Decrease in the number of cesarean deliveries	Decrease in the number of requests for analgesia	Less pregnancy-related weight-gain	Decrease in recovery time postpartum	Negative effects of exercise on the newborn
Baciuk et al.	NS	S	NM	NM	NS
Barakat et al.	NM	NM	NM	NM	NS
Bungum et al.	NS	NM	NM	NM	NM
Domenjoz et al.	S	NS	S	NM	NS
Price et al.	S	NM	NS	S	NS
Salvesen et al.	NM	NM	NM	NM	S
Tinloy et al.	NS	NM	NM	NM	NS

Key: S=Significant; NS=Not Significant; NM=Not Measured

## Discussion

The study of exercise regimens during pregnancy and their effects on the recovery of women postpartum is important because postpartum recovery is often overlooked and adverse outcomes are common. Some of the adverse obstetric and neonatal outcomes of overweight and obese mothers include diabetes and its complications, preterm birth, cesarean section, post partum hemorrhage, macrosomia, and low birth weight in varying ethnic and racial groups.<sup>7, 10</sup> Kader and Naim-Shuchana propose that because excess weight during pregnancy is associated with elevated risks of serious complications for both the mother and the baby during pregnancy and childbirth, exercise to ward off excessive weight gain in pregnancy could help avoid difficult deliveries and long recovery times post partum.<sup>7, 10</sup>

The main findings of this review include that women who participated in the exercise regimens were less likely to 1) need a cesarean delivery, 2) request analgesia during labor, and 3) gain excessive weight in pregnancy. Other articles found that mothers participating in the

exercise regimens also benefited from decreased recovery time postpartum, reduced incidence of hypertension during pregnancy, and improved aerobic fitness and muscular strength.<sup>11</sup> Even inactive women who began their exercise regimens at 12-14 weeks of gestation improved both delivery and recovery outcomes.<sup>11</sup> Negative effects from exercise programs on the newborns was nonexistent in most articles and occurred rarely with Olympic level athlete mothers.<sup>12</sup>

The findings of the articles discussed here are important to medical professionals as well as mothers and families. Decreased rates of cesarean deliveries will contribute to faster recovery times. Decrease in weight gain and hypertension will mean healthier pregnancies and lesser chances of comorbidities later. Improved aerobic fitness and muscular strength will mean maternal bodies are more prepared for labor and better able to heal properly after. These findings provide better evidence with which to encourage pregnant mothers to exercise even when they have not participated in exercise regimens before.<sup>11</sup> The lack of harm to the fetus provides practitioners with evidence with which to encourage exercise not only for the health of the mother but also with the assurance that the baby will not be harmed by it.

## **Limitations**

As noted in the Comparison of Study Designs table the outcomes measured often varied widely among studies and articles making drawing conclusions difficult. A lack of uniformity of studies and their lack of statistically significant results provided further difficulty drawing conclusions. Single articles often reported statistically significant data on one or more topics regarding maternal recovery postpartum, but often the articles did not agree. Many articles did not measure the same variables and few found similar conclusions. The total number of participants also varied greatly. In all the studies there was a distinct patient population and while

some articles had diverse populations generalizing is still not possible globally. In some articles the participants also had to be free of gestational diabetes, preeclampsia, high blood pressure and abnormal bleeding during the pregnancy. More studies need to be done on differing patient populations including patients with varying comorbidities.

Potential reasons for the results not being statistically significant include sample sizes that are not large enough and some articles that are not randomized control trials and thus cannot prove causality. Loss to follow up due to the difficulty of contacting moms after delivery also contributed to lack of statistical significance. Many papers also used self-report as the main method of data collection on the exercise routines of pregnant women; better studies might collect data in a more objective way. There is a risk of bias from article authors at the study and outcome level. There is also a risk of incomplete retrieval of identified research or reporting bias at the review level.

## **Conclusion**

There is evidence for utilizing a structured exercise regimen throughout pregnancy to decrease risk of caesarean section, to decrease the need for anesthesia during labor and delivery, to decrease pregnancy related weight-gain, to decrease maternal recovery time postpartum, to reduce the incidence of hypertension in pregnancy and to improve aerobic fitness and muscular strength in mothers. More research needs to be done to strengthen the evidence for encouraging regular exercise in pregnant women to decrease these risks and to establish statistical significance for other measures of maternal recovery postpartum. Studies should be reproduced on a larger scale and with diverse groups of women in order to achieve statistical significance and allow for better clinical evidence to be utilized by providers and taught to patients.

## **Implications for Practice**

With knowledge from these studies and articles practitioners can make recommendations to individual patients and healthy pregnant mothers in general in their practices. Since women obtain a lot of their medical information from their healthcare providers, providers need to be up-to-date on current research. Many women enjoy exercise yet worry about potential harm to their babies that may be induced by their actions during pregnancy. The Barakat article provides clinicians with evidence-based research to cite when encouraging worried mothers to exercise during pregnancy.<sup>2</sup> The Baciuk study contributes to knowledge in the field of obstetrics and gynecology especially in regards to requests for analgesics during labor and delivery. If a pregnant patient asks a provider how she can avoid the need for analgesics during delivery, the provider can recommend regular aerobic activity through pregnancy as a possible method to increase physical endurance and decrease the need for analgesics during labor and delivery.<sup>1</sup> The Domenjoz article supports the hypothesis that regular exercise regimens followed throughout pregnancy are beneficial to both the mother and the baby as seen in the reduction in cesarean deliveries. This is important clinically because clinician-recommended exercise regimens when not contraindicated will help women avoid cesarean deliveries and gain significantly less weight during pregnancy, while not affecting the health of the baby.<sup>6</sup>

## **Implications for Research**

The literature was often inconsistent and did not use large sample sizes. Another gap seen in the literature was that all the articles required participants to have low risk pregnancies. In many articles the participants had to be free of gestational diabetes, preeclampsia, high blood pressure and abnormal bleeding during the pregnancy. Further studies could focus on healthy pregnant mothers with large sample sizes and varying ethnicities. Other studies could focus on pregnant women with comorbidities or high-risk pregnancies. These studies could serve to inform practitioners if exercise regimens could reduce labor and delivery risks and problems with postpartum recovery in these high-risk groups as well.

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