Historically, pregnant women were considered vulnerable and were advised to reduce their level of activity. In 2002, the American College of Obstetricians and Gynecologists (ACOG) updated their recommendations for exercise during pregnancy to be less restrictive; these recommendations were reaffirmed by the ACOG in 2009. However, a survey of physicians found that more than 60% of physicians were not familiar with the current ACOG guidelines for exercise during pregnancy. Although limited by a small sample size that included physicians in both obstetrics and gynecology and family medicine in one geographic region, this study highlights the deficiency in knowledge regarding this subject.

In general, exercise reduces the morbidity and mortality associated with cardiovascular disease, hypertension, and type 2 diabetes mellitus among other chronic diseases. Nevertheless, only 20.3% of American adults meet weekly exercise recommendations. Similarly, compliance with physical activity guidelines is low both prior to and during pregnancy. Additionally, studies have consistently shown that women tend to decrease their physical activity during pregnancy. Since pregnancy itself is a life-changing event for many women, it is also a time when other lifestyle changes may be enacted, such as smoking cessation, adopting a healthy diet, or beginning routine exercise. Additionally, as female participation in sports increases, the safety of training during pregnancy has become an important issue.

Exercise offers potential benefits to both maternal and fetal health. Exercise in Pregnancy: A Clinical Review

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Context: Health professionals who care for pregnant women should discuss potential health benefits and harms of exercise. Although most pregnant women do not meet minimal exercise recommendations, there are a growing number of physically active women who wish to continue training throughout pregnancy.

Evidence Acquisition: A search of the Web of Science database of articles and reviews available in English through 2014. The search terms exercise pregnancy, strenuous exercise pregnancy, and vigorous exercise pregnancy were used.

Study Design: Clinical review.

Level of Evidence: Level 3.

Results: With proper attention to risk stratification and surveillance, exercise is safe for the mother and fetus. Benefits of exercise in pregnancy include reduction in Cesarean section rates, appropriate maternal and fetal weight gain, and managing gestational diabetes. Exercise as a means of preventing gestational diabetes, preeclampsia, or perinatal depression cannot be reliably supported. Overall, the current evidence suffers from a lack of rigorous study design and compliance with physical activity interventions.

Conclusion: Research thus far has been unable to consistently demonstrate proposed benefits of exercise in pregnancy, such as preventing gestational diabetes, preeclampsia, or perinatal depression. However, moderate- and high-intensity exercise in normal pregnancies is safe for the developing fetus and clearly has several important benefits. Thus, exercise should be encouraged according to the woman’s preconception physical activity level.

Keywords: pregnancy; exercise; strenuous; review
Gestational Diabetes Mellitus

In parallel to its effect on the incidence of type 2 diabetes mellitus, regular exercise should also decrease the risk of gestational diabetes mellitus. However, several review articles have concluded that there is insufficient evidence to support physical activity as an effective intervention to decrease the risk of developing gestational diabetes. Poor compliance to exercise regimens may have contributed to the lack of significance. Nevertheless, multiple studies have shown significantly lower glucose levels on the 24- to 28-week oral glucose tolerance test in physically active women. Although physical activity may not prevent the development of gestational diabetes, it may help manage it. The majority of studies using exercise as an intervention to treat gestational diabetes mellitus were successful. Women diagnosed with gestational diabetes at 24 to 34 weeks of pregnancy who performed resistance exercise were less likely to require insulin during the remainder of their pregnancy as compared with women with gestational diabetes in the control group. Additionally, exercise modulates maternal weight gain in pregnancy and reduces the risk of large-for-gestational age newborns, which are concerns with gestational diabetes.

Hypertension and Preeclampsia

Hypertension and preeclampsia are significant sources of morbidity and mortality in pregnancy. Although physical activity is known to be helpful in preventing cardiovascular disease, a similar association between physical activity in pregnancy and hypertension or preeclampsia has not been definitively shown. Data reported from the North Carolina Pregnancy Risk Assessment Monitoring System indicate that gestational hypertensive complications are less likely in women who are physically active before and during pregnancy. Conversely, an increased risk of developing preeclampsia was shown with greater than 270 minutes of exercise per week in a prospective cohort study of 85,139 pregnant Danish women. A 2012 review of randomized control, cohort, and case-control studies suggests that there is a trend toward a preventive effect of physical activity on the development of preeclampsia. However, there were a dearth of studies, and the evaluation of the few studies was complicated by differing methodologies, including the quantification of physical activity and the diagnosis of preeclampsia.

Maternal-Fetal Circulation and Fetal Growth

There is theoretical concern that exercise may negatively impact the developing fetus in terms of hemodynamics and growth. However, this is unsubstantiated in the current literature. Multiple studies have shown that blood flow to the fetus is not significantly altered by moderate-intensity physical activity. Interestingly, an increase in total vascular volume, capillary surface area, and parenchymal density was demonstrated in the placentas of women delivering at term who had exercised during the first half or all of their pregnancy.

Overall, birth weight was not significantly different between physically active women and inactive women. Additionally, several studies have demonstrated that women who were physically active had a decreased risk of having babies that were large for gestational age. Although additional studies would be beneficial, research thus far indicates that physical activity is safe for the developing fetus.

Labor and Delivery

Regular exercise may shorten the duration of labor and reduce the risk of Cesarean section and operative-assisted vaginal delivery. Improved tone of abdominal and pelvic floor musculature and aerobic fitness may be important factors. Evidence-based support for this is limited, as there are few contradictory results. Women who participated in an exercise program throughout their pregnancies had a lower percentage of Cesarean section and instrumental vaginal deliveries compared with a control group. This was in contrast to an earlier randomized controlled trial showing that there was no significant difference in Cesarean section and instrumental vaginal deliveries for women participating in an exercise program compared with a control group. However, the exercise program was only from weeks 20 to 36 of gestation compared with weeks 6 to 39 in the later study. In another study, aerobic fitness was tested only in nulliparous women, which can affect labor duration, and a higher maximal oxygen consumption (VO2 max) as a measure of aerobic fitness was associated with an approximately 30-minute shorter labor duration.

Perinatal Depression

Since exercise is associated with fewer depressive symptoms in adults with clinical depression, it has also been hypothesized that exercise would alleviate symptoms of depression during pregnancy and postpartum. Although several studies report a decrease in depressive symptoms on questionnaires in women who are physically active, the findings are not consistent. One study showed that pregnant women who were exercising 1 to 2 times per week, but not 3 times or more per week, were less likely to report depression, while another study reported decreased depression in pregnant women who exercised 4 times or more per week but not less than 4 times per week. Additionally, it is not clear whether the lower depression scores reported are clinically significant. A meta-analysis of 5 randomized controlled trials concluded that there is insufficient evidence to determine whether exercise reduces symptoms of postpartum depression.

GUIDELINES FOR WEIGHT GAIN IN PREGNANCY

Weight gain is tracked throughout pregnancy as it has important ramifications on both maternal and fetal health. Excessive weight gain is associated with gestational diabetes, preeclampsia, and postpartum weight retention. In 2013, the ACOG endorsed the Institute of Medicine’s weight gain goals.
during pregnancy based on a woman's body mass index (BMI) at her first prenatal visit. According to these recommendations, women with a normal BMI (18.5-24.9 kg/m²) should gain 25 to 35 pounds whereas overweight (BMI 25-29.9 kg/m²) and obese (BMI >30 kg/m²) women should aim to gain 15 to 25 pounds and 11 to 20 pounds, respectively. In 1 study, approximately 40% of normal-weight women and 60% of overweight women gained more weight than the upper limit of the respective range recommended by the Institute of Medicine. Exercise can help manage weight gain during pregnancy. Women who attended all 24 supervised exercise sessions during a 12-week program stayed within the Institute of Medicine's weight gain guidelines compared with 62% of the control group. Overall, the compliant members of the exercise group had significantly less weight gain and postpartum weight retention compared with the control group.

GUIDELINES FOR EXERCISE IN PREGNANCY

The ACOG reaffirmed their 2002 committee opinion on exercise in pregnancy in 2009. Based on these recommendations, women who are currently physically active can continue exercising while those who are physically inactive are encouraged to start exercising. The American College of Sports Medicine's (ACSM) physical activity guidelines calling for “30 minutes or more of moderate exercise . . . on most, if not all, days of the week” is advised for normal pregnancies. Sixteen percent of pregnant women meet these recommendations; for comparison, only 20% of nonpregnant women comply with the ACSM physical activity recommendations. Additionally, pregnant women should be cautioned to avoid exercise in the supine position after the first trimester; exercise involving prolonged standing due to significant decreases in cardiac output; exercise with a high risk of contact, falling, or abdominal trauma due to the risk of injury to the mother or the fetus; exercise at altitudes greater than 5250 feet due to concerns for fetal hypoxemia, and scuba diving due to the risk of the fetus developing decompression sickness. Table 1 provides a summary of the exercise guidelines.

EXERCISE PRESCRIPTION

Before advising the initiation or continuation of physical activity during pregnancy, a physician must assess the woman’s risk level. Healthy women without contraindications to exercise are

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Table 1. Summary of guidelines for exercise during pregnancy

| A pregnant woman with no absolute or relative contraindications to exercise should be advised to |
|---------------------------------------------------------------|
| 1. Perform at least 30 minutes of moderate-intensity exercise on most days of the week |
| 2. Avoid exercise involving the following conditions: |
|   a. Supine position after the first trimester |
|   b. Prolonged standing |
|   c. High risk of contact, falling, or abdominal trauma |
|   d. Altitudes greater than 5250 feet |
|   e. Scuba diving |
| 3. Stop exercise for any of the following signs or symptoms: |
|   a. Vaginal bleeding |
|   b. Dizziness |
|   c. Calf pain or swelling |
|   d. Chest pain |
|   e. Preterm labor |
|   f. Decreased fetal movement |
|   g. Leakage of amniotic fluid |
|   h. Dyspnea prior to physical activity |

*These guidelines apply to uncomplicated pregnancies. Please see text for the absolute and relative contraindications to exercise in pregnancy.
considered low risk regardless of their previous activity level, whereas women with certain chronic medical conditions, including cardiovascular, respiratory, and systemic diseases, or relative contraindications are considered high risk.10,11 Familiarity with absolute and relative contraindications to exercise is thus important for both the physician and patient. Absolute contraindications include gestational hypertension, preeclampsia, ruptured membranes, incompetent cervix, bleeding in the second or third trimester, multiple gestation at risk for premature labor, placenta previa, and premature labor.1 Relative contraindications include intrauterine growth restriction, extremes of weight, and poorly controlled medical comorbidities, such as type 1 diabetes mellitus, hypertension, seizure disorder, and thyroid disease.1 Pregnant women should also stop exercising based on signs and symptoms that may develop (Table 1).33,51

The frequency, intensity, type, and time duration (FITT) should be outlined according to her physical activity state prior to pregnancy. The PARmed-X for pregnancy is a set of guidelines developed in Canada to help health practitioners evaluate a pregnant woman’s ability to safely engage in physical activity as well as prescribe a basic exercise regimen.43

PHYSICAL TRAINING IN PREGNANCY

With more women competing in sports, strenuous exercise in pregnancy has become an important topic to those who wish to continue training during pregnancy. According to the ACOG, the main concerns in this population are the effect of pregnancy on competing and the effect of training on the pregnancy.10

Continuing high-intensity exercise throughout pregnancy significantly increased the participants’ VO2 peak from week 17 gestation to 12 weeks postpartum,34,51 this training regimen of muscle strengthening, aerobic exercise, and endurance exercise could be used to guide exercise prescription for physically active women.

Although there are limited studies that examine the safety of high-intensity physical activity on the fetus, the results are mostly reassuring.35,50,51 There was a decreased risk of preterm birth with increased frequency of first trimester vigorous recreational physical activity, and birth weight was not significantly affected by this level of physical activity.35 Women classified as nonexercisers, moderately active, or vigorously active based on their physical activity 6 months prior to pregnancy performed a moderate-intensity exercise test during the second trimester.30 As postexercise biophysical profiles were normal and there were no significant differences among the groups in APGAR scores or birth weights, this study suggests that physically inactive women can safely start moderate-intensity exercise while physically active women can continue or increase their activity to vigorous-intensity exercise during pregnancy. Additionally, the 3 groups of women performed a peak exercise test to detect the effect of strenuous physical activity on fetal well-being.31 Again, biophysical profiles were ultimately reassuring in all groups. Notably, in 5 vigorously active women, there were transient fetal heart rate decelerations as well as altered uterine blood flow immediately after exercise, which raises concerns of reduced blood flow to the uterus with strenuous exercise. Similarly, in a small study of 6 pregnant Olympic-level endurance athletes, maternal-fetal circulation during and after exercise showed that vigorous exercise, where the maternal heart rate was greater than 90% of the maximum, was associated with decreased uterine artery blood flow and fetal bradycardia that resolved soon after exercise was stopped.11,51 Thus, even though there may be fetal cardiovascular changes associated with high-intensity exercise, they do not appear to significantly affect neonatal outcomes; however, there is cause for concern.

CONCLUSION

For women without contraindications to physical activity, exercise is safe for both the woman and developing fetus. Although there is no conclusive evidence that exercise effectively prevents gestational diabetes mellitus, preeclampsia, or perinatal depression, it does appear to have beneficial effects on reducing glucose levels, the risk of Cesarean section or instrumental vaginal deliveries, and maternal weight gain. In general, women who are physically active prior to pregnancy should be advised to maintain, and counseled that they can increase, their level of activity if desired, while physically inactive women should be encouraged to begin exercising.

Clinical Recommendations

| Clinical Recommendation | SORT Evidence Rating |
|-------------------------|----------------------|
| Pregnant women should be encouraged to exercise.3 | C |
| Maternal exercise is safe for the developing fetus.2,7,23,32,50 | B |
| Physically active women can continue or increase their level of activity during pregnancy.34,49-51 | B |
REFERENCES

1. ACOG Committee Obstetric Practice. ACOG Committee opinion. Number 267, January 2002. Exercise during pregnancy and the postpartum period. Obstet Gynecol. 2002;99:171-175.

2. American College of Obstetricians and Gynecologists. ACOG Committee opinion no. 548: weight gain during pregnancy. Obstet Gynecol. 2015;125:210-212.

3. Amezcue-Practo C, Olmedo-Requena R, Jimenez-Mejias E, et al. Changes in leisure time physical activity during pregnancy compared to the prior year. Matern Child Health J. 2013;17:652-658.

4. Artal R, Sherman C. Exercise during pregnancy: safe and beneficial for most. Phys Sportsmed. 1999;27:51-75.

5. Barakat R, Cordero Y, Coteron J, Luaces M, Montejo R. Exercise during pregnancy improves maternal glucose screen at 24-28 weeks: a randomized controlled trial. Br J Sports Med. 2012;46:656-661.

6. Barakat R, Pelaez M, Lopez C, Montejo R, Coteron J. Exercise during pregnancy reduces the rate of cesarean and instrumental deliveries: results of a randomized controlled trial. J Matern Fetal Neonatal Med. 2012;25:2572-2576.

7. Barakat R, Ruiz JR, Rodríguez-Romo G, Montejo-Rodríguez R, Luaces M. Does exercise training during pregnancy influence fetal cardiovascular responses to an exercise stimulus? Insights from a randomized, controlled trial. Br J Sports Med. 2010;44:762-764.

8. Barakat R, Ruiz JR, Stirling JR, Zakynthinaki M, Luaces A. Type of delivery is not affected by light resistance and toning exercise training during pregnancy: a randomized controlled trial. Am J Obstet Gynecol. 2009;201:e1-e6.

9. Bauer PW, Broom CM, Pivarnik JM. Exercise and pregnancy knowledge among healthcare providers. J Womens Health (Larchmt). 2010;19:335-341.

10. Bredin SS, Foulds HJ, Burr JF, Charlesworth SA. Risk assessment for physical activity and exercise clearance: in pregnant women without contradictions. Can Fam Physician. 2013;59:515-517.

11. Bung P, Huch R, Huch A. Maternal and fetal heart rate patterns: a pregnant athlete during training and laboratory exercise tests; a case report. Eur J Obstet Gynecol Reprod Biol. 1991;39:59-62.

12. Camporesi EM. Diving and pregnancy. Phys Sportsmed. 1999;27:51-75.

13. Charlesworth S, Foulds HJ, Burr JF, Charlesworth SA. Evidence-based risk assessment and recommendations for physical activity clearance: pregnancy. Appl Physiol Nutr Metab. 2011;36(suppl 1):535-548.

14. Chu SY, Callaghan WM, Bish CL, D’Ambrolo D. Gestational weight gain by body mass index among US women delivering live births, 2004-2005: fueling future obesity. Am J Obstet Gynecol. 2009;200:271.e1-7.

15. Clark SL, Cotton DH, Pivarnik JM, et al. Position change and central hemodynamic profile during normal third-trimester pregnancy and post partum. Am J Obstet Gynecol. 1991;164:885-887. Erratum in: Am J Obstet Gynecol. 1991;165:241.

16. Duley A, Jolly K, MacArthur C. The effectiveness of exercise in the management of post-natal depression: systematic review and meta-analysis. Fam Pract. 2009;26:154-162.

17. de Barnos MC, Lopes MA, Francisco RP, Sapientza AD, Zugaib M. Resistance exercise and glycemic control in women with gestation diabetes mellitus. Am J Obstet Gynecol. 2005;203:566.e1-e6.

18. Deisenler AL, Siegr-Riz AM, Everson KR. Physical activity during pregnancy and the risk of hyperglycemia. J Womens Health (Larchmt). 2012;21:769-775.

19. Demissie Z, Segar-Riz AM, Everson KR, Herring AH, Dole N, Gaynes BN. Physical activity and depressive symptoms among pregnant women: the PINS study. Arch Womens Ment Health. 2011;14:145-157.

20. de Oliveira Melo AS, Silva JL, Tavares JS, Barros VO, Leite DF, Amorim MM. Effect of a physical exercise program during pregnancy on uteroplacental and fetal blood flow and fetal growth: a randomized controlled trial. Obstet Gynecol. 2012;120:310-311.

21. Dye TD, Knox KL, Artal R, Aubry BH, Woytowycz MA. Physical activity, obesity, and diabetes in pregnancy. Am J Epidemiol. 1997;146:961-965.

22. Enlin PL, Coffin L. Physiologic basis for recommendations regarding exercise during pregnancy at high altitude. High Alt Med Biol. 2004;5:521-534.

23. Ertan AK, Schanz S, Tanriverdi HA, Meyberg R, Schmidt W. Doppler examinations of fetal and uteroplacental blood flow in AGA and IUGR fetuses before and after maternal physical exercise with the bicycle ergometer. J Perinat Med. 2004;32:260-265.

24. Everson KR, Wen F. Prevalence and correlates of objectively measured physical activity and sedentary behavior among US pregnant women. Prev Med. 2011;51:39-45.

25. Gaston A, Prayveshia H, Tired, moody and pregnant? Exercise may be the answer. Psychol Health. 2015;28:1553-1569.

26. Gjestland K, Bo K, Owe KM, Eberhard-Gran M. Do pregnant women follow exercise guidelines? Prevalence data among 5482 women, and prediction of low-back pain, pelvic girdle pain and depression. Br J Sports Med. 2015;47:515-520.

27. Hulstal LA, Bo K. Exercise in pregnant women and birth weight: a randomized controlled trial. BMC Pregnancy Childbirth. 2011;11:66.