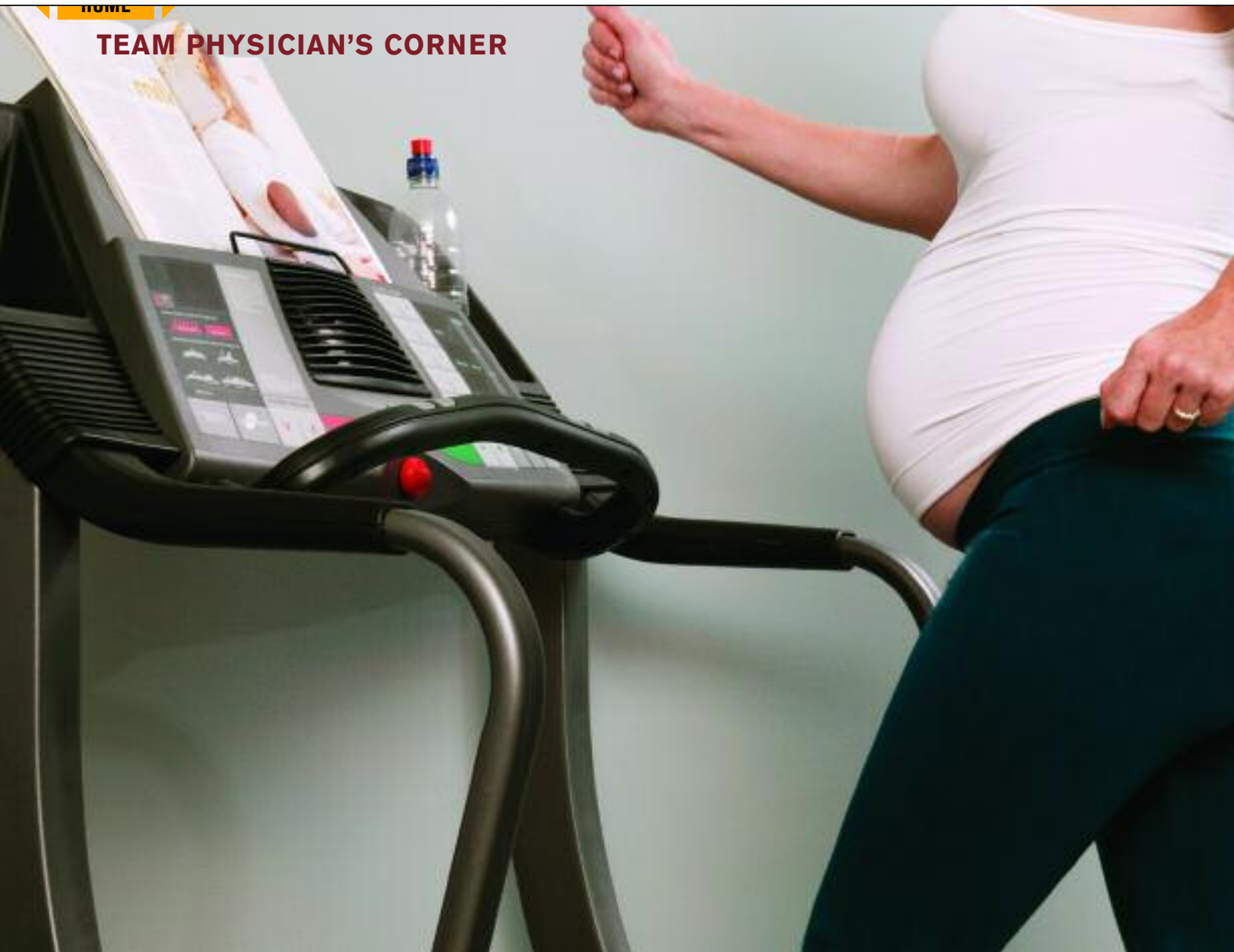


**TEAM PHYSICIAN'S CORNER**

THE PREGNANT ATHLETE

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During pregnancy, many physiologic changes occur that affect athletic conditioning and exercise; however, these changes do not routinely require abstinence from exercise. In fact, exercise has a number of maternal and fetal effects, many of which are beneficial. Beginning a regular exercise regimen before conception and continuing it during pregnancy may have several positive effects on maternal physiologic adaptations to pregnancy, which may lead to fetoprotective effects later in pregnancy.¹²



The normal physiologic changes of pregnancy, effects of exercise on the mother and the fetus, recommendations for exercise during pregnancy, contraindications, and postpartum return to activity will be reviewed.

Physiologic Changes

Cardiovascular System: The blood volume increases by almost 50 percent during pregnancy. The increase in plasma volume occurs before the increase in red cell mass, leading to a dilutional anemia in the second trimester that corrects by term. Stroke volume, cardiac output, and resting heart rate also increase. In well-conditioned athletes, blood volume increases are greater than in sedentary women.¹⁷ Blood pressure falls slightly, reaches a nadir in the second trimester, and rises to prepregnancy levels by term.

Respiratory System: The anatomy of the chest wall changes in pregnancy, allowing for increased oxygen transport and utilization. The ribcage has increased elasticity, flaring, and expansion, and the diaphragm elevates. Tidal volume, minute ventilation, and oxygen consumption all increase during pregnancy. The respiratory changes of pregnancy facilitate gas exchange between the mother and the fetus through the placenta. Changes in maternal oxygenation are amplified in the fetus. Therefore,

prolonged anaerobic exercise should be avoided to prevent maternal acidosis and hypoxia which will induce fetal acidosis and hypoxia. However, aerobic exercise in pregnant women causes greater increases in minute ventilation than in nonpregnant women and this hyperventilation can protect against harmful shifts in blood oxygenation or pH.¹⁷

Musculoskeletal System: Changes in posture, gait, balance, and joint laxity occur due to the physical changes of pregnancy. The center of gravity moves forward and upward due to the significant enlargement of the breasts and uterus. This results in spinal lordosis which pregnant women compensate for by abducting the shoulders and flexing the cervical spine. Progesterone and relaxin increase pelvic and joint laxity during pregnancy. Due to all the musculoskeletal changes during pregnancy, pregnant women theoretically have a greater propensity for falling and for excess torque forces on lax joints which may predispose them to more sprains.¹⁴

Maternal Effects of Exercise

Regular exercise enhances placental growth and the normal physiologic changes of pregnancy. Potential maternal benefits of exercise during pregnancy include maintenance of musculoskeletal and cardiovascular fitness, avoidance of excessive weight gain,



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and decreased musculoskeletal complaints such as back pain. Women who exercise during pregnancy tend to have increased energy, improved moods, and better quality sleep. Additionally, exercise may be beneficial in the primary prevention of gestational diabetes, especially in morbidly obese women (BMI >33).¹⁶

Fetal Effects of Exercise

Potential effects of sustained weight-bearing exercise on the fetus include reduced birth weight and decreased labor stress. This reduced birth weight may result from a combination of early delivery (one week earlier than sedentary women) and decreased brown fat.^{7,10} However, brown fat is important for energy and heat regulation in infants, especially in premature

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TABLE 1: Warning Signs to Terminate Exercise While Pregnant²

- Vaginal bleeding
- Dyspnea prior to exertion
- Dizziness
- Headache
- Chest pain
- Muscle weakness
- Calf pain or swelling
- Pre-term labor
- Decreased fetal movement
- Amniotic fluid leakage

TABLE 2: Absolute Contraindications to Aerobic Exercise While Pregnant²

- Hemodynamically significant heart disease
- Restrictive lung disease
- Incompetent cervix/cerclage
- Multiple gestation at risk for premature labor
- Persistent second- or third-trimester bleeding
- Placenta previa after 26 weeks of gestation
- Premature labor during the current pregnancy
- Ruptured membranes
- Preeclampsia/pregnancy-induced hypertension

TABLE 3: Relative Contraindications to Aerobic Exercise While Pregnant²

- Severe anemia
- Unevaluated maternal cardiac arrhythmia
- Chronic bronchitis
- Poorly controlled type I diabetes
- Extreme morbid obesity
- Extreme underweight (BMI <12)
- History of extremely sedentary lifestyle
- Orthopedic limitations
- Poorly controlled seizure disorder
- Poorly controlled hyperthyroidism
- Heavy smoker



infants; thus, decreased fat deposition may have adverse consequences in the preterm infant. Babies born to exercising mothers tolerate labor well and show less behavioral or biochemical evidence of undue stress in late pregnancy and labor.¹² When compared to age-matched controls, offspring of exercising mothers have slightly better



Pre-pregnancy exercise routines should be resumed gradually based on individual physical capacity.

motor skills at one year of age and are much leaner with better performance on intelligence testing at 5 years old.^{10,11}

Acute Maternal-Fetal Effects During Exercise

Acutely, exercise has relatively little effect on the fetus or uterus when the mother and fetus are healthy. Theoretical concerns regarding increased core temperature during pregnancy have not been found to be significant because core temperature in exercising pregnant women did not reach potentially teratogenic levels (teratogenic potential at 102.5 degrees).¹ Also, physiologic changes during pregnancy, including lower resting temperature, sweating threshold, and decreased venous tone, facilitate greater heat exchanges across the skin and result in smaller temperature elevations during pregnancy. Prospective data from athletes show that during intense

exercise fetal heart rates remain normal.¹⁸ Additionally, maintaining intense exercise during the third trimester up to the onset of labor does not affect fetal oxygenation as measured by cord blood and amniotic fluid erythropoietin.⁹ The placenta plays an important role in maintaining this homeostatic environment for the fetus. Women who exercise regularly have been shown to have larger placentas with improved blood flow and gas exchange efficiency.¹⁵

Effects of Exercise on Labor

Intense physical activity can induce contractions due to decreased uterine blood flow and increased catecholamines. However, moderate- to high-intensity regular exercise does not increase the pregnant athlete's risk of premature labor and delivery.⁸ Although there is no increase in rates of preterm deliveries in exercising pregnant women, patients who exercise regularly tend to deliver one week earlier than patients who do not exercise.¹⁹ Continuing moderate- to high-intensity training also decreases labor times and the rate of medical intervention, including use of pitocin, forceps, and delivery by cesarean section. However, these trends are not seen in those who begin exercise during pregnancy or who continue a low-intensity training regimen.⁸

Recommendations for Exercise in Pregnancy

There is no evidence that exercise has a detrimental effect on pregnancy, labor, or fetal well-being. For women without risk factors for maternal/perinatal complications after physician evaluation, the American College of Obstetricians and Gynecologists recommends the following:

- Pregnant women may adhere to the CDC/ACSM recommendation for moderate exercise of 30 minutes or more per day on most days. Intensity of activity should be modified based on development of maternal warning signs (see Table 1).³ Pregnant women should stop exercising when fatigued and not exercise to exhaustion.

- Exercise in the supine position and motionless standing should be avoided after the first trimester. During pregnancy, the supine position results in relative obstruction of venous return causing decreased cardiac output and orthostatic hypotension. Motionless standing is also associated with decreased cardiac output.¹³

In general, participation in a wide range of recreational activities appears to be safe. Sport safety is primarily determined by the specific movements and potential for contact inherent in the sport. Contact sports (e.g., ice hockey, soccer, and basketball) should be avoided due to the risk of abdominal trauma and injury to both the mother and fetus.⁵ Similarly, sports with an increased risk of falling (e.g., gymnastics, running, downhill skiing, and racquet sports) should be avoided. Additionally, scuba diving is not recommended because the fetus is at increased risk for decompression sickness due to the inability of the fetal pulmonary circulation to filter bubble formation.⁶

Other issues that must be considered during pregnancy include altitude, adequate diet, and heat dissipation. Exertion at altitudes up to 6,000 feet appears safe; however, engaging in physical activities at higher altitudes carries various risks.⁴ Women who exercise during pregnancy must pay particular attention to caloric intake. Pregnancy requires an additional 300 kcal/day to maintain metabolic homeostasis. Heat dissipation must be maximized during pregnancy. Strategies to improve heat dissipation include adequate hydration, appropriate clothing, and optimal environmental surroundings. Sauna or hot tub use after exercise should be avoided.

Postpartum Return to Full Activity

Many of the physiologic and morphologic changes that occur during pregnancy persist for four to six weeks postpartum. When returning to activities, athletes must be aware of the detraining that occurs during pregnancy in addition to the variations in individual recovery rates



postpartum. Thus, prepregnancy exercise routines should be resumed gradually based on individual physical capacity. Moderate weight reduction while nursing has been shown to be safe and does not compromise neonatal weight gain. Additionally, postpartum exercise is associated with a reduced incidence of postpartum depression in physically active mothers.¹⁴

Contraindications to Exercise in Pregnancy

Recommendations to exercise are applicable to those without risk factors for adverse maternal or fetal outcome. These principles may be modified based on any potential risk factors. Absolute and relative contraindications to exercise during pregnancy should be evaluated on an individual basis (see Tables 2 and 3).

Conclusion

Exercise during pregnancy offers a number of potential benefits for the mother and fetus. Recommendations for safe exercise practices should be reviewed with pregnant athletes to maximize benefits and avoid possible complications. Risks of exercise must be evaluated on an individual basis and exercise programs should be modified accordingly.

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Recommended Reading

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