

The Risks and Benefits of Exercise During Pregnancy

Robert W. Jarski, PA-C, PhD, and Diane L. Trippett, MS

Rochester, Michigan

There are benefits as well as risks associated with physical activity in all individuals, but there are some special medical considerations for the pregnant woman. The purpose of this article is to review the possible risks and benefits of exercise during pregnancy as presented in the literature, and to provide appropriate recommendations. There are some potential risks to the fetus resulting from maternal exercise including hypoxia, hyperthermia, and abnormal heart rate changes. The benefits, however, appear to outweigh the risks when they are minimized by prescribing appropriate exercises and using recommended precautions. Because human studies on exercise during pregnancy are currently limited, exercise prescriptions should be conservative. Swimming, biking, and aerobic walking are not associated with reported problems. Moderate aerobic exercise is safe provided the pregnancy is known to be normal. Contraindications to aerobic exercise during pregnancy include conditions that limit cardiorespiratory reserves. If a woman has been participating in an exercise program before gestation, she may be encouraged to continue the program at a moderate level if her pregnancy is normal. *J Fam Pract* 1990; 30:185-189.

Exercise, active sports, and physical fitness have become a normal part of life for many. With today's emphasis on health promotion and disease prevention, many women are continuing to exercise during pregnancy.

Specific physiological and anatomical changes during pregnancy are similar to those that occur during strenuous exercise by nonpregnant individuals. During pregnancy the changes again increase and might result in some risk to the woman and to the fetus. There are benefits as well as risks associated with physical activity in all individuals, but there are some special health considerations for the pregnant woman. Family physicians are especially suited to integrate the medical aspects of exercise with a patient's psychological and physical capabilities.

A MEDLINE computer-assisted literature search found few experimental studies relating directly to humans. This article reviews the clinically useful literature and examines the fetal and maternal risks and benefits of exercise during pregnancy.

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From the School of Health Sciences, Oakland University, Rochester, Michigan. Requests for reprints should be addressed to Robert W. Jarski, PA-C, PhD, School of Health Sciences, Oakland University, Rochester, MI 48309-4401.

FETAL RISKS

Potential risks to the fetus resulting from maternal exercise include (1) hypoxemia, (2) harmful heart rate changes, (3) hyperthermia, and (4) problems associated with extremes in barometric pressure while exercising at high altitudes and underwater (snorkel or scuba diving).

Hypoxemia

During exercise, the blood flow to working muscles and organs increases with a concurrent decrease of blood flow to other organs.¹ When there is decreased blood flow to the uterus, there may be an inadequate oxygen supply to the fetus.^{2,3} Anderson² showed that exercise during the third trimester of pregnancy resulted in decreased uterine blood flow. If a woman is physically conditioned, however, there is less of a decrease in uterine blood flow resulting from physiological adaptations, including a decreased response of catecholamines and possibly other vasoconstrictors affecting the uterus.^{4,5}

Heart Rate Changes

Another potential risk is that exercise might cause fetal heart stresses. In a study by Hauth et al,⁶ the fetuses of

women who jogged 1.5 miles three times per week before and during pregnancy were evaluated by a nonstress test at 28 to 38 weeks' gestation. There was no bradycardia, and moderate maternal exercise did not result in acute fetal distress. Dressendorfer and Goodlin⁷ investigated the fetal heart rate response at 32 to 39 weeks' gestation in pregnant women who were swimming 30 to 45 minutes at least three times each week. Fetal heart rate averaged 149 beats per minute ($SD = 5$) during lap swimming, which increased the maternal heart rate to 80% of the predicted maximum. There were increased fetal movements with exercise, but no sustained exercise-induced changes, tachycardia, or bradycardia. These studies suggest that moderate maternal exercise may have no harmful effects on the fetal heart rate.

Hyperthermia

In both animal and human studies, maternal hyperthermia has been shown to increase the risk of fetal abnormalities.^{8,9} Some physiological mechanisms, however, are known to prevent hyperthermia in pregnant women. Jones et al¹⁰ investigated the effects of increased temperatures resulting from exercise in conditioned women who ran 3 or more miles four or more times per week. Each woman's core, vaginal, and skin temperature was measured at 12, 24, and 32 ± 1 weeks' gestation, and postpartum. Measurements were obtained at rest, at 5-minute intervals while exercising, and at 5 and 15 minutes after exercising. The mean resting skin temperature increased throughout pregnancy, although the maternal core and vaginal temperatures never exceeded 39 °C. All subjects gave birth to healthy full-term infants with normal neonatal physical examinations including the neurological examination.

The 40% increase in maternal blood volume that occurs during pregnancy appears to help transfer heat from the fetus.^{3,11} Also, an increase in the woman's skin temperature probably represents a maternal thermoregulatory response that prevents fetal exposure to excess temperatures.¹⁰ Decreased uterine or placental blood flow,³ coupled with elevated internal maternal temperatures, however, might result in fetal hyperthermia.

Extremes in Barometric Pressure

Exercise activities that involve extreme barometric pressures warrant special precautions during pregnancy because of changes in oxygen and nitrogen partial pressures and other specific factors explained below.

Decreased Barometric Pressures

Activities under decreased barometric pressure include living at high altitudes and mountain sports. Moore et al¹²

found that hormonal and other factors intrinsic to pregnancy may be responsible for a twofold increase in the maternal hypoxic ventilatory response at high altitudes. In their cardiopulmonary study, Baumann and Huch¹³ found that at altitudes of 2500 m or less, maternal low exercise levels (3 minutes on a bicycle ergometer) were not associated with significant fetal heart rate changes (from 142 ± 8 to 145 ± 7 beats per minute) during normal pregnancies even when the woman's cardiorespiratory signs increased: heart rate from 104 ± 11 to 129 ± 20 beats per minute, systolic blood pressure from 117 ± 7 to 145 ± 35 mm Hg, diastolic blood pressure from 74 ± 9 to 106 ± 31 mm Hg, and respiration from 12 ± 1 to 20 ± 4 per minute. They concluded that fetal compensatory mechanisms are multifold and surprisingly effective during normal pregnancies of healthy women. If a mother has diabetes mellitus, preeclampsia, anemia, or a past smoking history, however, and ascends to altitudes of 2500 m or greater, precautions are justified to avoid potentially harmful increases in the fetal heart rate.

The fetuses of airline stewardesses may be at special risk. Newer aircraft, such as the Boeing 747, usually maintain a cabin pressure equal to an altitude of 2000 m or less. The 707 and DC-9, however, have cabin pressures as high as 2640 m.¹³ The fetuses of stewardesses may therefore be at special risk because of the combined effects of working at high altitudes and passive smoking.

In their Colorado high-altitude study, Moore et al¹⁴ found that pregnancy-induced hypertension was more frequent at an altitude of 3100 m than at 2400 m, and proteinuria and edema of the upper extremities were more frequent at 3100 m than at 1600 m. It was concluded that maternal hypoxia may play a role in pregnancy-induced hypertension. In addition, high-altitude residence has been associated with fetal growth retardation, and altitude-induced hypoxia may aggravate maternal cardiac diseases,¹⁵ further compromising the fetus.

Increased Barometric Pressures

Scuba and snorkel diving result in increased barometric pressures where inhaled nitrogen from air dissolves in blood and other tissues.¹⁶ Upon ascending to decreased barometric pressures at the surface, nitrogen tends to come out of solution and may form embolic bubbles. Appropriate ascent procedures while scuba diving assure the safe return to atmospheric pressures for the woman. The gas-absorption characteristics of human fetal tissues under changing ambient pressures, however, are not

known. Snorkel diving for long periods below the surface results in nitrogen accumulation in maternal tissues; accumulation might occur in fetal tissues as well.

The dynamics of gas absorption in adult tissues are well established, and scuba and snorkel diving in this age group is safe using recommended procedures and precautions. Because there is insufficient and sometimes contradictory information about the effects of nitrogen and other gases in fetal tissues, scuba and snorkel diving below the surface during any stage of pregnancy is currently not recommended. There are no medical contraindications to snorkeling at the surface.

MATERNAL RISKS

Specific maternal cardiovascular alterations help accommodate fetal development. There is a 30% to 50% increase in cardiac output¹⁷ during pregnancy, and the resting oxygen consumption rate increases by 30%.¹⁸ These cardiovascular factors may help facilitate exercise during pregnancy.

On the other hand, increased lumbar lordosis, anterior pelvic tilt, increased laxity of the ligaments,¹⁹ and some other musculoskeletal changes adversely affect a woman's ability to exercise during pregnancy. The total body mass increases an ideal average of 15% to 30%.²⁰ Changes in lumbar lordosis and pelvic tilt affect a woman's posture and make carrying extra weight (such as a backpack) difficult or painful. Added to the weight gain of pregnancy, these changes might increase the risk of back strain and other musculoskeletal injuries, especially if the woman was predisposed to such injury prior to pregnancy. Extended periods of walking, even without extra loads, might become difficult, especially after the second trimester. Jogging and other weight-bearing activities result in increased stress and microshock (repetitive vibration trauma) of the joints.

Although some nonexperimental studies have associated exercise during pregnancy with increased uterine contractions²¹ and prematurity and low birthweight,²² a well-conducted experimental study using objective measures does not support these claims. Veille et al²³ studied 17 subjects in their third trimester of pregnancy. Neither weight-bearing (running) nor non-weight-bearing (stationary bicycle) exercise groups showed an increase in uterine activity above the resting rates, and the subjects gave birth to infants weighing 3802 ± 478 g at 40 ± 1 weeks' gestation. The investigators cast doubt upon any direct relationship between exercise and increased uterine activity.

MATERNAL BENEFITS

The general benefits of aerobic exercise for most nonpregnant individuals are familiar to most clinicians. Some benefits that might also help pregnant women include (1) reducing blood pressure, (2) decreasing other cardiovascular risks such as clot formation, (3) helping to maintain an ideal body weight, and (4) managing stable diabetes.^{1,4} In addition, some beneficial effects of exercise on labor and delivery have been documented.

Pregnant women who exercise have generally shorter labors, and faster, easier deliveries.^{2,24,25} A study²⁴ of conditioned female athletes showed that the second stage of labor was shorter, presumably owing to strengthened abdominal muscles. The first stage, however, was prolonged because of the rigidity of the uterus and strong muscle tone. In a study of 67 runners who continued to run during pregnancy, there was a 1.5% abortion rate,³ which is lower than the 15% to 20%¹⁵ expected in the normal population. The study did not examine possible decreases in fertility.

Another generally accepted benefit is the psychological "lift" perceived by those who exercise. A study by Wallace et al²⁵ showed that pregnant women who exercised had higher self-esteem measured by the Rosenberg Self-Esteem Scale. A cause-and-effect relationship between exercise and high self-esteem, however, has not been established. High self-esteem was also associated with a decrease in the number of complaints of backaches, headaches, and fatigue in an exercising group compared with a nonexercising group. The exercise group also had less shortness of breath, probably because exercising women are more conditioned for difficult breathing.

If exercise continues after delivery, the benefits appear to continue. By promoting blood flow, exercise helps decrease varicosities, leg cramps, and peripheral edema.²⁰

RECOMMENDATIONS

Exercise prescriptions should be individualized, taking into account the woman's total medical status along with her home situation. A patient education plan should encourage those physical activities that promote the potential benefits of exercise during pregnancy (Table 1). Pregnant women should be instructed to monitor their own heart rates accurately and to avoid overexertion. An easy way to monitor exertional stress is to use the exercise-talk test. If a woman cannot exercise and talk simultaneously, she is approaching a compromising respiratory or heart rate. The heart rate should increase no more than 60% to 70% of the predicted maximum²⁶ (220 beats per minute minus age in years), and the heart and respiratory rates

TABLE 1. BENEFITS AND RISKS OF EXERCISING DURING PREGNANCY

Potential Benefits	Potential Fetal Risks	Potential Maternal Risks
Maintenance of ideal body weight	Hypoxemia	Increased joint stress and microshock
Control of blood pressure	Harmful heart rate changes	Back strain
Management of stable diabetes	Hyperthermia	Increased uterine activity*
Decreased backaches, headaches, fatigue, shortness of breath	Prematurity, low birthweight*	
Shorter labor, easier delivery		
Decreased clot formation, varicosities, leg cramps, edema		
Higher self-esteem		

*Conflicting data reported in the literature.

should return to their resting rates within 15 minutes after exercising. Even moderate exercise should not continue to exhaustion; frequent rest periods should be recommended.

Morton et al⁴ recommend 30 minutes of exercise three times per week. Some physically fit women will be able to exercise safely longer and more frequently. Conditioned runners may generally continue the duration of their activity, but they should reduce their speed as pregnancy progresses.⁴ All pregnant women involved in an exercise program need to adjust their exercise level to accommodate fatigue, joint and ligament pain, nausea, or vomiting.^{2,3,20}

Because studies on exercise during pregnancy are currently limited, prescribed activity levels should be conservative. Available studies have resulted in some recommendations for those women who aerobically exercise during gestation (Table 2). Swimming, aerobic walking, and biking in moderation are not associated with the problems cited in the literature, and these activities are safe and recommended if performed regularly.

Biking requires especially good coordination and balance. Although the placement of the body's center of gravity changes during the course of pregnancy, the change is gradual, and proprioceptive mechanisms adjust effectively. Most women will not have difficulty with balance while biking if it is learned before pregnancy and performed regularly throughout gestation. Stationary biking requires less balancing and may be safely performed by nearly all women.

Stretching exercises, walking at normal speeds, and

TABLE 2. RECOMMENDATIONS AND CONTRAINDICATIONS TO EXERCISING DURING PREGNANCY

Recommendations	Contraindications
Comprehensive prenatal evaluation	Anemia
Patient education on exercise, self-monitoring of heart rate	Thyroiditis
Heart rate $\leq 70\%$ of maximum	Hypertension, heart disease
Thirty minutes of aerobic exercise 3 times per week	Mild or severe preeclampsia
Frequent rest periods	Premature labor, cervical bleeding
Heart and respiratory rates should return to resting rates within 15 minutes after exercising	Multiple pregnancy
Body temperature never $>40^{\circ}\text{C}$	
Ideal activities: swimming, biking, aerobic walking	History of complicated pregnancy
Stretching exercises ²⁷ and normal walking for those unable to exercise aerobically	Hot tubs, saunas
	Strenuous activity in hot or humid environments
	Activities at high altitudes with shortness of breath
	Snorkel or scuba diving

other nonaerobic exercises are recommended for all women including those unable to participate in aerobic activities. Exercises such as those described in detail by Noble²⁷ may be safely prescribed during pregnancy.

PRECAUTIONS

Moderate aerobic exercise is safe provided the pregnancy is known to be normal.^{3,4,25} There should be (1) only one fetus, (2) no heart disease, (3) no complications with past pregnancies, and (4) no prohibiting physical disabilities (Table 2). If a woman has not been exercising aerobically before pregnancy, she should not begin during pregnancy.^{2,4} Moderate, nonaerobic exercises²⁷ are safe for all women who wish to improve their health during pregnancy.

Prolonged exercise should be avoided in hot, humid environments. The woman's body temperature should never exceed 40°C . Hot tubs and saunas should not be used, especially after exercising, because of the risk of fetal hyperthermia.

CONTRAINDICATIONS

Contraindications to aerobic exercise include (1) conditions that limit cardiac or respiratory reserves, such as

anemia or thyrotoxicosis; (2) pregnancy-induced hypertension; (3) multiple pregnancy; and (4) premature labor, cervical bleeding, or other obstetric complications (Table 2). Activities at high altitudes causing extreme shortness of breath should be avoided. Scuba and snorkel diving below the surface are not recommended until future research documents fetal safety.

CONCLUSIONS

With relatively few published research studies available, it is difficult to determine with certainty whether the benefits of exercise during pregnancy outweigh the risks. There is no evidence in the literature indicating that moderate exercise within the recommended guidelines will be harmful to the woman or to the fetus. If a woman has been participating in an exercise program before gestation, she should be encouraged to continue the program at a moderate level if her pregnancy is normal.

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