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Resistance Training During Pregnancy: Safe and Effective Program Design

Brad Schoenfeld, MSc, CSCS
Exercise Science Department, Lehman College, Bronx, New York

SUMMARY

A REGIMENTED PROGRAM OF RESISTANCE TRAINING CAN PROVIDE A MULTITUDE OF BENEFITS FOR THE PREGNANT WOMAN. HOWEVER, A WOMAN UNDERGOES SIGNIFICANT PHYSIOLOGICAL AND MORPHOLOGICAL CHANGES THROUGHOUT THE TERM, AND THESE ISSUES NEED TO BE TAKEN INTO ACCOUNT WHEN DESIGNING A ROUTINE. THEREFORE, THE PURPOSE OF THIS PAPER WILL BE 3-FOLD: (A) REVIEW THE BENEFITS OF MATERNAL RESISTANCE EXERCISE, (B) DISCUSS ITS SAFETY, AND (C) OUTLINE A SPECIFIC RESISTANCE TRAINING PROTOCOL BASED ON THE CURRENT RESEARCH AND PRACTICAL EXPERIENCE TO ENSURE A SAFE, EFFECTIVE MATERNAL WORKOUT EXPERIENCE. SAMPLE ROUTINES WILL BE PROVIDED TO ILLUSTRATE PROGRAM DESIGN.

INTRODUCTION

Regimented exercise is universally regarded as having a positive effect on health and wellness. It is associated with a decreased incidence of disease, improved functional capacity, and better mental health. Yet despite the overwhelming body of research supporting its efficacy, a large percentage of the population remains sedentary and do not come close to meeting minimum guidelines set forth by the American College of Sports Medicine for physical activity (34).

Women tend to be less active than men, especially in terms of performing moderate to vigorous physical activity (78). This is even more apparent with respect to the exercise habits of pregnant women–a subgroup that has perhaps the most to gain from staying active–where it is estimated that more than 60% of expectant mothers remain sedentary throughout the term (86). The health-related implications of maternal fitness are so important that the Institute of Medicine identified pregnancy as a period of critical risk for inactivity and obesity, placing those who fall into these categories at increased risk for various chronic disease states and premature mortality (35). Therefore, the purpose of this article will be 3-fold: first, to review the benefits of maternal resistance exercise; second, to discuss its safety, and; third, to outline a specific resistance training protocol and sample routine based on the current research and practical experience.

BENEFITS OF MATERNAL EXERCISE

Physical activity conveys numerous benefits for the pregnant woman. However, the interpretation of research on maternal exercise is somewhat complicated by the fact that many studies do not discern between types of physical activity performed (aerobic versus anaerobic). Therefore, it is not entirely clear to what extent some of these benefits are realized from resistance training compared with aerobic training. Emerging research on resistance training during pregnancy does suggest that it supplements and augments the benefits conferred by aerobic exercise, as well as building muscular strength and improving functional capacity in a manner that is not possible with aerobics alone (34,85). The following is an overview of what can be ascertained from the current literature.

IMPROVED WEIGHT MANAGEMENT

The majority of U.S. women experience their greatest weight gain during the childbearing years of 25–34, a phenomenon largely attributed to weight gain accumulated while pregnant. Research indicates much of this excess weight gain can be attenuated by adhering to a regular program of prenatal exercise (18).

KEY WORDS:
maternal fitness; exercise during pregnancy; resistance training during pregnancy; strength training and pregnancy

Clapp and Little (21) found that pregnant women who maintained physical activity levels gained 20% less weight while pregnant than those who remained inactive. The same study also showed substantially lower 5-site skinfold thicknesses in the exercise group after the 15th week of the term. Similarly, Barakat et al. (6) found that resistance training during pregnancy substantially attenuated maternal weight gain over the course of term. Other studies have shown that women who gained more than the recommended amount of weight during pregnancy were significantly heavier at long-term follow-up than women who gained the recommended amount or less (69,66). This is significant not only for health during pregnancy but also because postpartum weight retention shows an inverse correlation with a woman's degree of prenatal physical activity (58) and may possibly even increase the risk of breast cancer (41).

REDUCED INCIDENCE OF GESTATIONAL DIABETES

Gestational diabetes mellitus (GDM) is the most common medical complication associated with childbirth, affecting up to 10% of all pregnancies. Women with GDM are prone to developing diabetes postpartum. Compounding matters, children born to mothers with GDM are at an increased risk of obesity, impaired glucose tolerance, and type II diabetes (63). Physically active women who exercise throughout pregnancy show substantially lower rates of GDM than women who do not (25,59,27). Compared to inactive women, those who exercise during pregnancy reduce their odds of acquiring GDM by 59%. This relationship endures after adjusting for age, race, education, parity, and body mass index (47). Those whose exercise levels are above the median do reduce their odds even further, indicating a benefit to performing a greater volume of exercise.

Brankston et al. (13) demonstrated that resistance training may help to reduce the need for insulin therapy in women with GDM. Using a random design, 32 afflicted patients were assigned to either a diet-only group or a group that combined diet plus resistance exercise. In comparison with the diet-only group, women in the combined diet-plus-exercise group were found to require less insulin and showed a longer delay from diagnosis to the instigation of insulin therapy.

DECREASED INCIDENCE OF PREECLAMPSIA

Preeclampsia is a pregnancy-related disorder that encompasses maternal hypertension, proteinuria, and edema. It can bring about seizure and/or cerebral hemorrhage and is the second leading cause of maternal death in the United States. Although data on the subject are somewhat limited, research suggests that regimented prenatal exercise may prevent or oppose the progression of the disease (83).

A case-controlled retrospective study performed by Marcoux et al. (51) found that women who were engaged in regular exercise had a reduced incidence of preeclampsia and gestational hypertension, with risk decreasing as the volume of exercise increased. Similarly, Sorensen et al. (72) reported that light prenatal exercise reduced the incidence of preeclampsia by 24%, whereas the performance of vigorous exercise (equal to 6 metabolic equivalents or more) led to a 54% reduction. It is theorized that this protective effect is because of the stimulation of placental growth and vascularity, reduction of oxidative stress, and/or exercise-induced reversal of maternal endothelial dysfunction (83).

ENHANCED BODY IMAGE

The changes in body anthropometry associated with pregnancy often lead to a reduced sense of body image (56,76). Many women report feeling fat and unattractive, and there appears to be a sharp decline in body image perception from preterm into early pregnancy (31).

Marquez-Sterling et al. (53) found that women who exercised during pregnancy had a significantly better body image than nonexercisers, a trend that extended into the latter stages of pregnancy. Moreover, Boscaglia et al. (12) reported that pregnant women who exercised at least 90 minutes a week at moderate intensity were significantly more satisfied with their bodies throughout the term than low exercisers. The authors concluded that women who participate in neonatal fitness programs respond more favorably to pregnancy-related changes in their bodies compared with women who remain sedentary.

BETTER PSYCHOLOGICAL WELL-BEING

Pregnancy is associated with alterations in mood, often leading to depressive episodes. Haas et al. (32) reported that the prevalence of depressive symptoms rises from 11.7% before pregnancy to 25.2% during the third trimester. Hormonal shifts, body changes, and impaired physical function play a role in reducing a woman's feelings of psychological well-being.

Studies show an inverse relationship between maternal physical activity and both the incidence and severity of depression (80,67,24). Nordhagen and Sundgot-Borgen (57) found that women who performed a moderate amount of neonatal exercise had lower scores on a test measuring depressive symptoms during pregnancy and into the postpartum period in comparison with those who were not active. Similarly, Koniak-Griffin (43) found that 6 weeks of exercise had profound effects on reducing anxiety in an ethnically diverse population study of pregnant teens. These findings are consistent with research in the general population that shows exercise to be as effective as medication in treating mild to moderate forms of depression (84,52,61). Factors contributing to this antidepressive effect are thought to include an increased biosynthesis of neurotransmitters, improved body composition, and better functional capacity.

Moreover, exercise does not have to be chronic to realize positive results. Even a single bout of exercise has been shown to improve scores of mood in pregnant women during their second and third trimesters (65).

REDUCED LOWER BACK PAIN

Lower back pain (LBP) is one of the most common pregnancy-related disorders, with 76% of women reporting lumbosacral pain at some point during the term (44). LBP during pregnancy can have wide-ranging effects, including interfering with the performance of activities of daily living and disturbing normal sleep patterns. In some cases, the pain can become so unbearable that it forces a woman to take a leave of absence from work, often rendering them to bed rest.

The genesis of prenatal LBP can be partially attributed to an increased lumbar lordotic curvature and altered center of gravity brought on by changes in body shape and composition, which places increased stress on the muscles of the lumbar region. This can be exacerbated by spinal ligament laxity resultant to an elevated secretion of the hormone relaxin. Given that increased mobility leads to a decreased joint stability (9), it stands to reason that the spinal joints are less capable of enduring the heightened physiological demands placed on them during pregnancy.

Multiple studies show that exercise helps to counteract lumbar stress and alleviate symptoms associated with LBP (26,77,40). Exercises that target the core musculature, herein defined as the postural muscles of the trunk, appear to be particularly effective in improving maternal back health. Garshasbi and Faghih Zadeh (30) found that pregnant women who participated in an exercise program specifically designed to strengthen the core reported a significant reduction in the intensity of LBP and related discomfort throughout the term.

IMPROVED FETAL DEVELOPMENT

In the recent past, women were advised to refrain from exercising during pregnancy to avoid any adverse outcome and ensure a healthy delivery. Not only has this myth been debunked but also studies suggest that prenatal exercise actually can have positive impact on the fetus.

Clapp et al. (23) observed that children born to women who performed weight-bearing exercise 3–5 times per week throughout pregnancy were longer and had more lean body mass than matched controls. Other studies show a reduction in fetal fat mass while maintaining lean tissue (36,20). Barakat et al. (6) found that prepregnancy maternal body weight was associated with increased bodyweight of the newborn in nonexercisers but not in those who performed resistance exercise. Moreover, resistance training reduced the risk of macrosomia in the offspring of those with GDM (5).

Positive effects of exercise on the fetus appear to extend into the postnatal period. The offspring of women who perform vigorous exercise throughout the term have been found to exhibit signs of heightened attentiveness and discipline, and by the age of 5, these children are neurodevelopmentally more advanced compared with control subjects (19). These results were attributed to the ability of regular exercise to increase blood volume, cardiac output, and placental function, which in turn increases 24-hour nutrient delivery to the placenta, thereby improving fetal nourishment.

EASIER LABOR

Exercise has been shown to have positive effects on multiple indices of labor, with high levels of resistance training showing a particularly beneficial effect (33). Women who are physically active during pregnancy have been shown to have a decreased risk of premature labor (42,68,10) and a reduced incidence of cesarean delivery and shorter hospitalization (33). A randomized controlled study on the impact of resistance training on delivery showed similar results between exercisers and controls with respect to type of delivery, with no negative effects noted in those who lifted weights (7).

Clapp (14) found that frequent exercisers experienced a shorter duration of active labor and a lower incidence of abdominal (6% versus 30%) and vaginal (6% versus 20%) operative delivery. In addition, there was a reduced incidence of acute fetal stress in the exercise group as compared with controls. Taken as a whole, these findings indicate that adoption of a regimented program of maternal exercise has no negative effects on delivery and generally results in an easier pregnancy with fewer complications.

SAFETY OF MATERNAL EXERCISE

The health of both mother and fetus is a paramount consideration when deciding whether to exercise during pregnancy. Until recently, most advice on the matter was based on the 1985 recommendations put forth in the American College of Obstetrics and Gynecologists (ACOG), which lacked scientific support and were overly conservative in their recommendations. Many of these recommendations were misguidedly based on studies involving various animal species. However, not only do animals have different physiological responses to training than humans but many of the studies involved pushing unfit species to the point of physical exhaustion–far beyond the exercise intensity employed by the majority of pregnant women (74).

Subsequent to these guidelines, a wealth of research has been conducted on humans, and the preponderance of studies appear to indicate that maternal exercise is safe when carried out by otherwise healthy women within their current abilities (1,70). Newer ACOG guidelines now state that, in the absence of medical complications, 30 minutes or more of moderate exercise on most if not all days of week is both safe and recommended for pregnant women (1). Pregnant women should always obtain physician's consent to participating in an exercise program. The following is an overview of the effects of exercise on specific aspects of health.

HYPERTHERMIA

There is a long-held belief that that exercise-induced hyperthermia can have detrimental effects on the fetus. Initial concerns on these risks were based on research in animals, where

heat stress during early stages of pregnancy led to an increased incidence of neural tube defects (28,55). Studies in humans, however, do not support this conclusion (37,55). Stevenson (72) reported no evidence that prenatal exercise induces hyperthermia nor did it have any teratogenic effects on the fetus.

Larsson and Lindqvist (45) found that low impact maternal exercise of up to 70% of maximal heart rate shows no significant increase in core temperature from pre-exercise levels, and none of the subjects even approached a dangerous body temperature. This is thought to be due to an earlier onset of sweating, which occurs at a continuously lower body temperature as term progresses (15). In addition, pregnancy-induced plasma volume expansion increases temperature and blood flow, accelerating the dissipation of heat (74).

MISCARRIAGE

One of the biggest exercise-related concerns among some pregnant women is miscarriage–fears that appear unfounded. By most accounts, spontaneous abortion is not associated with the level of physical activity (22,50,2). Latka et al. (46) actually showed that those who exercised during pregnancy had a lower rate of spontaneous abortion compared with those who were inactive. A randomized controlled study comparing resistance training with a control group showed that exercise was not associated with premature delivery and had no negative effects on gestational age (7).

These results have been shown to extend to vigorous exercise too. Clapp et al. (16) reported that previously fit women who continued to train at a level above current guidelines during pregnancy showed no difference in rate of spontaneous abortion, congenital abnormalities, or implantation problems. And according to Kardel (38), a high volume and/or intensity of training in initially fit women poses no adverse risks to the mother or fetus.

In contrast, Madsen et al. (49) reported a positive correlation between exercise early in pregnancy and the risk of pregnancy loss. However, the author's themselves acknowledge that the study was flawed in its design, noting that the data showed signs of recall bias, with the women's knowledge of their miscarriage affecting the way they reported physical activity levels.

JOINT-RELATED INJURIES

A valid concern with maternal exercise is the risk of a soft tissue injury to the joints. During pregnancy, there is an increase in joint laxity brought on by an increased secretion of the hormone relaxin (3). This makes joints less stable, heightening the possibility of strain and tear of muscles, tendons, and ligaments.

Despite this valid physiological basis, however, research does not show an increased incidence of maternal exercise-related injury rates in general (17,79) and specifically resulting from participation in resistance training programs (5,8), provided proper guidelines are followed. Sternfeld et al. (73) showed that musculoskeletal complaints actually decreased among those who train regularly. Given that resistance training has been shown to increase connective tissue strength (29,75), it would seem to be a particularly beneficial exercise modality for reducing injury risk in pregnant women.

RESISTANCE TRAINING GUIDELINES FOR PREGNANCY

Before engaging in a resistance training program, pregnant women should always get medical clearance from their physician. Assuming no contraindications exist (Tables 1 and 2), a comprehensive resistance training program can be an integral component of a maternal exercise program (1,64).

The primary consideration when designing a routine should be the health of both mother and fetus. The general training goal should seek to maintain a reasonable level of fitness rather than optimize it, with the specific protocol based on the expectant mothers' current fitness level (74,1). Based on the current literature, vigorous maternal exercise has not been shown to produce any adverse effects in women who are well trained and potentially can help to sustain high levels of health and fitness and increase exercise adherence throughout pregnancy (38,39). Thus, research suggests that those with considerable training experience can be allowed to continue exercising at or near their current level of activity without adverse effects. However, additional research needs to be conducted before this recommendation can be definitively made. Any decision concerning exercise levels should be made in consultation with the woman's physician.

When designing a routine, particular emphasis should be placed on training the core musculature, which can help to counteract lumbar stress and alleviate symptoms associated with LBP (26,77,40,30). Static, endurance-based core exercises (see descriptions of these exercises in Table 3) are ideal for the pregnant woman because they have been shown to promote back health while minimizing stress to the spine (54). Dynamic core exercises, such as crunches, also can help to improve core strength, although these movements tend to become difficult as term progresses and may be best tolerated during the first trimester.

Although no definitive research has been performed to assess optimal maternal training frequency, it has been the author's experience that a 3-day-a-week routine can be employed with excellent success. Training should be performed on nonconsecutive days to allow for sufficient neuromuscular recuperation (48). A greater frequency of resistance training is unnecessary at this time, given the aforementioned goals of maternal exercise, and could possibly result in overtraining, given the physiological and psychological changes seen during pregnancy (5).

It has been the author's experience that a total body routine may be preferable to a split routine because it helps to prevent blood from pooling in a particular area of the body (5). When using this approach, a single exercise should be performed for each of the major

Table 1
Absolute contraindications to exercise during pregnancy

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

Derived from guidelines provided by the Canadian Society for Exercise Physiology (Canadian Society for Exercise Physiology [CSEP]. Physical Activity Readiness Medical Examination for Pregnancy [PARmed-X for Pregnancy]. Available from CSEP, Ottawa, Canada, 1996).

Table 2
Relative contraindications to exercise during pregnancy

● Severe anemia
● Unevaluated maternal cardiac arrhythmia
● Chronic bronchitis
● Poorly controlled type 1 diabetes
● Morbid obesity
● Extreme underweight (body mass index <12)
● History of extreme sedentary lifestyle
● Intrauterine growth restriction in current pregnancy
● Poorly controlled hypertension
● Orthopedic limitations
● Poorly controlled seizure disorder
● Poorly controlled hyperthyroidism

Derived from guidelines provided by the Canadian Society for Exercise Physiology (Canadian Society for Exercise Physiology [CSEP]. Physical Activity Readiness Medical Examination for Pregnancy [PARmed-X for Pregnancy]. Available from CSEP, Ottawa, Canada, 1996).

muscle groups. The one exception here pertains to the core musculature, which may benefit from the use of multiple movements. Beginners should perform 1 set per exercise, whereas intermediate and advanced trainees can realize further benefits from 2 to 3 sets (5). Rest between sets should last approximately 2 minutes, allowing enough time for recovery of maternal heart rate. To optimize functional ability, a multiangled approach should be taken, where exercises are varied in all 3 planes of movement. All modalities of resistance training can be employed, including free weights, machines, cables, bands, and body weight movements.

Given that joints are significantly more lax during pregnancy, a higher repetition range is recommended using an intensity of less than 70% 1RM (10 repetitions [reps] or more per set). This may decrease joint-related stress and hence reduce the prospect of injury (3). Sets should be somewhat challenging but should not progress to the point of absolute muscular fatigue. Similarly, static exercises should be held until the muscles are challenged but not to the point where the woman can no longer maintain the support of her bodyweight.

The Valsalva maneuver should be avoided at all costs because breath holding increases both heart rate and blood pressure and can decrease splanchnic blood flow and uterine perfusion (81), which can potentially be dangerous to the fetus. Expectant mothers should be instructed to breathe out on the concentric portion

Table 3
Static core exercise descriptions

● Plank: Lie on your stomach with your palms on the floor, feet together, and spine in a neutral position. Lift your body up on your forearms and toes, keeping your body as straight as possible. Maintain this position for as long as possible and challenge yourself to maintain longer periods in the plank position.
● Bird dog: Assume an all-fours position, chin up, spine in a neutral position. Simultaneously extend your right leg and left arm, so they are parallel to the floor. Hold this position for as long as possible and then repeat with the opposite arm and leg.
● Side bridge: Lie on your right side, legs straight, right palm on the floor, feet stacked one on top of the other. Straighten your right arm, keeping it in line with shoulder, and place your free hand on your opposite shoulder. Hold this position for as long as possible and then repeat on the opposite side.

of each dynamic movement and inhale on the eccentric action; during static exercises, breathing should be regimented throughout the duration of exercise (82).

Repetition speed should be slow to moderate, taking approximately 2 seconds on the concentric action and 3 seconds on the eccentric action. Given that motionless standing tends to cause pooling of venous blood and can decrease cardiac output, it is best to stay active between sets (81,3). This can be accomplished by walking around the room or performing light dynamic stretching movements.

Prenatal exercise should always begin with a light warm-up and end with a brief cooldown. Generally, 5–10 minutes of light cardiovascular activity is generally sufficient for both the components. It is best to exercise after meals to avoid hypoglycemia. Most importantly, it is essential to be aware of the warning signs to stop exercise should adverse symptoms arise (Table 4).

Table 4
Warning signs to terminate exercise session

● Vaginal bleeding
● Dyspnea before exertion
● Dizziness
● Headache
● Chest pain
● Muscle weakness
● Calf pain or swelling (r/o thrombophlebitis)
● Preterm labor
● Decreased fetal movement
● Amniotic fluid leakage

Derived from guidelines provided by the Canadian Society for Exercise Physiology (Canadian Society for Exercise Physiology [CSEP]. Physical Activity Readiness Medical Examination for Pregnancy [PARmed-X for Pregnancy]. Available from CSEP, Ottawa, Canada, 1996).

SPECIFIC EXERCISE GUIDELINES FOR PREGNANCY

The first trimester is the most important period for fetal growth, including development of limbs and internal organs. During this time, major physiological changes take place without significant changes in maternal anthropometry (11). While blood volume expands and the uterus enlarges, weight gain averages less than 4.5 kilograms. Thus, there generally is no need to modify exercises based on morphological considerations.

Despite evidence that maternal exercise-induced hyperthermia is not a concern, it is nevertheless prudent to take precautionary measures and avoid large increases in body temperature while exercising during pregnancy (81). This can be facilitated by wearing loose-fitting clothing and making sure the training environment is cool and well ventilated. Moreover, it is essential to keep well hydrated throughout exercise to increase heat dissipation. Consuming 8 oz of water before training and then an additional 8 oz for every 15 minutes of exercise is a good rule of thumb to maintain fluid balance. Any loss of weight after exercise is due to water loss and should be replaced with fluid in the post-exercise period at an amount equating to 1 pt of fluid per pound of weight lost (3).

Secretion of relaxin increases significantly during the first trimester, causing joints to become less stable (3). Hence, it is particularly important for the pregnant woman to use proper form during exercise. Ballistic movements should be avoided as they can heighten the possibility of strains and tears of muscles, tendons, and ligaments. Accordingly, Olympic exercises, such as cleans and snatches, are contraindicated because they are high-intensity plyometrics.

The first trimester is often complicated by nausea, vomiting, and excessive fatigue. These maladies can have a profound effect on a woman's ability to exercise, and exercise intensity therefore should be modified accordingly. When in doubt, it is best to err on the side of caution. Table 5 provides a sample resistance training routine that can be employed during the first trimester. Note that many other exercises can be substituted, provided that proper guidelines are followed.

Significant changes in body habitus take place throughout the second and third trimesters, with weight gain averaging 22–35 pounds. Compounding matters, weight gain is centered about the midsection, altering posture and center of gravity (62). This can make the execution of many exercises difficult or impossible to perform. Breathing can become more difficult due to the fetus pressing on the diaphragm (3). It therefore can be necessary to modify exercises to suit a woman's comfort level. If necessary, towels and pillows can be used to facilitate performance.

Several exercise-related restrictions are warranted at the onset of the second trimester. First, the supine position should be avoided as it tends to obstruct venous return from the uterus compressing the vena cava. This can decrease cardiac output and result in orthostatic hypotension (4).

Second, exercises that require forward flexion at hips and/or waist should be avoided after the first trimester. The pregnant woman's uneven weight distribution tends to make these moves awkward and places increased stress on the lumbar region (60). They also can result in dizziness and/or heartburn. As an alternative, a modified all-fours position (knees and elbows on

Table 5 Sample routine for first trimester			
Muscle group	**Exercise**	**Sets**	**Repetitions**
Back	Lat pull-down	2–3	10–15
Shoulders	Shoulder press	2–3	10-15
Chest	Dumbbell chest press	2–3	10–15
Biceps	Concentration curl	2–3	10–15
Triceps	Lying triceps extension	2–3	10–15
Frontal thighs	Lunge	2–3	10–15
Glutes/hamstrings	Stiff-legged deadlift	2–3	10–15
Calves	Toe press	2–3	10–15
Core	Crunch	2–3	10–15
Core	Plank	2–3	Timed
Core	Side bridge	2–3	Timed

floor) can be employed to target the gluteal muscles and hamstrings (71).

Finally, overhead lifting exercises should be avoided after the first trimester. Postural changes can place excessive stress on the lower back, and overhead movements tend to exacerbate lumbar stresses. Front raises, lateral raises, and reverse flies can be substituted for shoulder presses to work the deltoid and rotator cuff muscles (71). Table 6 provides a sample routine that can be employed during the second and third trimesters. Note that many other exercises can be substituted, provided that proper guidelines are followed.

CONCLUSION

Maternal fitness is essential to the health and wellness of expectant mothers. Resistance training, in particular, can provide a plethora of physiological and psychological maternal benefits as well as helping to improve functional ability throughout the term. By following proper guidelines, a pregnant women can safely engage in a comprehensive resistance training program. Physician's clearance should always be obtained to rule out any contraindications before commencing a routine. To derive optimal benefits, exercises should be carried out in all 3 planes of movement with an emphasis on core stability. One to 3 sets of 10–15 reps is suggested, taking approximately 2 minutes rest between sets. In the absence of any complication or contraindication, there appears to be no reason that in most cases training cannot continue until immediately before delivery.

Table 6 Sample routine for second and third trimesters			
Muscle group	**Exercise**	**Sets**	**Repetitions**
Back	Seated row	1–3	10–15
Shoulders	Lateral raise	1–3	10–15
Chest	Seated machine chest press	1–3	10–15
Biceps	Dumbbell curl	1–3	10–15
Triceps	Triceps kickback	1–3	10–15
Frontal thighs	Dumbbell squat	1–3	10–15
Glutes/hamstrings	Cable back kick	1–3	10–15
Calves	Standing calf raise	1–3	10–15
Core	Plank	1–3	Timed
Core	Bird dog	1–3	Timed
Core	Side bridge	1–3	Timed

Brad Schoenfeld *is a lecturer in the exercise science department at Lehman College and the President of Global Fitness Services, Scarsdale, NY.*

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