Adding Strength Training, Exercise Intensity, and Caloric Expenditure to Exercise Guidelines in Pregnancy

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Several versions of exercise guidelines for pregnancy have been published, the latest 9 years ago. These guidelines recommend 30 minutes or more of moderate exercise on most if not all days of the week for pregnant women in the absence of medical or obstetric complications. However, moderate-intensity exercise was not defined. In addition, the specific weekly energy expenditure of physical activity was not suggested. Recent research has determined that, compared with less vigorous activities, exercise intensity that reaches at least 60% of the heart rate reserve during pregnancy while gradually increasing physical-activity energy expenditure reduces the risk of gestational diabetes. To achieve the minimum expenditure of 16 metabolic equivalent task-hours/wk, one could walk at 2 miles/h for 6.4 h/wk (2.5 metabolic equivalent task-hours, light intensity) or, preferably, exercise on a stationary bicycle for 2.7 h/wk (6 to 7 metabolic equivalent task-hours, vigorous intensity). To achieve the target expenditure of 28 metabolic equivalent task-hours per week, one could walk at 2.0 miles/h for 11.2 h/wk (2.5 metabolic equivalent task-hours, light intensity) or, preferably, exercise on a stationary bicycle for 4.7 h/wk (6 to 7 metabolic equivalent task-hours, vigorous intensity). The more vigorous the exercise, the less total exercise time is required. Light muscle strength-training performed during the second and third trimesters of pregnancy has minimal effect on newborn body size and overall health. On the basis of this and other information, updated recommendations for exercise in pregnancy are suggested.

Women of childbearing age are at increased risk of gestational diabetes mellitus (GDM), which has been linked strongly to obesity. Weight gain during pregnancy can be excessive, and some women tend to retain that weight after delivery. Gaining excessive weight during pregnancy can result in obesity-associated comorbidities, which are a major health concern in the United States.

In 2002, the American College of Obstetricians and Gynecologists published its latest guidelines for exercise in pregnancy. These constituted general public health recommendations, suggesting 30 or more minutes of moderate exercise a day on most if not all days of the week for pregnant women in the absence of medical or obstetric complications. However, there were no specifics on the definition of moderate-intensity exercise or the recommended amount of weekly physical-activity energy expenditure for optimal outcome.

It has been a decade and a half since the initial Centers for Disease Control and Prevention and American College of Sports Medicine recommendations were established and 9 years since their adoption by the American College of Obstetricians and Gynecologists. Since then, new science has emerged that has enhanced our understanding of the amount of physical-activity expenditure needed and the intensity of exercise needed to improve health outcomes and quality of life.

The purpose of this Current Commentary is to highlight exercise guidelines in pregnancy in a con-
Exercise format for obstetricians and gynecologists. These recommendations provide evidence that increasing weekly physical-activity expenditure while incorporating vigorous exercise provides optimal health outcomes for pregnant women and their fetuses, and they suggest that light strength training during the second and third trimesters does not negatively affect newborn body size and overall health.

Suggested Guidelines
Increasing the Amount of Vigorous-Intensity Exercise is an Important Goal for Pregnant Women, Especially Those who are Overweight or Obese

Nonoxidative type IIb muscle fibers (which burn minimal fat) are increased in obese women (body mass index [BMI], calculated as weight (kg)/[height (m)]^2) 30 or higher) and are related directly to BMI. The greater the BMI, the more type IIb muscle fibers a woman possesses. In addition, the greater the BMI, the lower the percentage of type I oxidative fibers (fat burning). Weight loss alone, or weight loss with physical activity, can improve muscle oxidative capacity in obese women with and without diabetes. The physical activity–induced increase in muscle oxidative capacity increases the capacity to burn fat throughout the day, which would limit weight gain.

In overweight and obese pregnant women, vigorous-intensity exercise, which increases the energy expenditure postexercise compared with low-intensity exercise, should limit weight gain. In fact, for a given energy expenditure, more intense exercise programs induce a greater loss of subcutaneous fat compared with a program of moderate intensity. Thus, we propose that higher intensity exercise may be an alternative means to improving oxidative capacity and increasing postexercise oxygen consumption so that, in overweight and obese pregnant women, body fat percentage is reduced by a greater extent compared with traditional low-intensity exercise and weight gain is limited.

To adhere to the exercise prescription, pregnant women should follow the rating of perceived exertion. The rating of perceived exertion is subjective and ranks overall effort of exertion and fatigue from 6 (no exertion) to 20 (maximal exertion). A rating of 6=no exertion at all, 7–8=extremely light, 9–10=very light, 11–12=light, 13–14= somewhathard, 15–16=hard, 17–18=very hard, 19=extremely hard, 20=maximal exertion. This scale scores the total exertion, overall exertion, and fatigue level of an exercise. The more exertion, the less total exercise time is required to reach the recommended weekly physical-activity expenditure goal. As shown in Table 1, the rating of perceived exertion for proposed light and vigorous physical activity options in pregnant women is around 12–14 and 15–16, respectively.

For every 4.5-kg (10-lb) increase in body weight, the weekly energy expenditure increases by about 76 kcal to achieve the minimum 16 metabolic equivalent task-h/wk category and increases by 133 kcal/wk for the target of 28 metabolic equivalent task-h/wk category. The minimum and target energy expenditures are based on recent data by Dempsey et al and Zhang et al. First, to obtain energy expenditure in metabolic equivalent task-hours per week, multiply the number of metabolic equivalent task-hours (the oxygen requirement) required for the activity by the number of hours the activity is performed multiplied by the total number of d/wk the activity is performed (eg, 5 metabolic equivalent task-hours×0.95 h/d×6 d/wk=28.5 metabolic equivalent task-h/wk). Second, to convert metabolic equivalent task-h/wk into kcal/wk of energy expenditure, multiply the metabolic equivalent task-h/wk by the resting metabolic rate and by 60 min/h (eg, 28.5 metabolic equivalent task-h/wk×3.5 mL O_2/kg/min×60 min=5,985 mL/kg/wk). Now, body weight is needed. For this example, the body weight of the person is 58.7 kg, so 5,985 mL/kg/wk×58.7 kg=351,319.5 mL/wk or 351.3 L/wk of oxygen consumed in total for physical activity. Because 5 kcal are yielded for every liter of oxygen consumed, then 351.3 L/wk×5 kcal/L=1,756.5 kcal/wk. To estimate total weekly physical-activity energy expenditure, as well as the weekly physical-activity energy expenditure from vigorous exercise, a questionnaire such as the 7D-PAR can be used.

Increasing Weekly Physical-Activity Energy Expenditure Is an Important Goal for Pregnant Women

A recent meta-analysis has shown that higher levels of physical activity in early pregnancy are associated with a 24% lower risk of developing GDM (pooled odds ratio 0.76, 95% confidence interval 0.7–0.83). Those women who had the highest levels of physical activity before pregnancy had approximately a 55% lower risk of developing GDM compared with women with the lowest levels physical activity (pooled odds ratio 0.45, 95% confidence interval 0.28–0.75).
Specifically, there is a relationship between energy expenditure in metabolic equivalent task-h/wk and GDM risk. Dempsey and colleagues have demonstrated that pregravid women who exercised 21.1 or more metabolic equivalent task-h/wk during the year before pregnancy reduced GDM risk by 74% and women who were pregnant and expended 28 or more metabolic equivalent task-h/wk during pregnancy reduced GDM risk by 33%.

Zhang and coworkers conducted a prospective cohort study to assess whether the amount, type, and intensity of pregravid physical activity are associated with GDM risk. The relative risks of GDM decreased with total pregravid weekly physical activity. Compared with women who did not exercise, women who expended 16 metabolic equivalent task-h/wk showed a 17% reduction in GDM risk, and expending 56 metabolic equivalent task-h/wk showed approximately a 30% reduction in GDM risk. As pregravid weekly vigorous physical activity increased (vigorous exercise intensity ≥ 6 METS or ≥ 21 mLO2/kg/min), the relative risk for GDM decreased by 20% and 25% if 6 and 15 MET-hours per week of vigorous physical activity were performed, respectively. Table 1 was created based on the data by Zhang, Dempsey, and their colleagues. The vigorous physical activity option reduces the total exercise time by about 60% compared with the light physical activity option.

### Table 1. Recommended Energy Expenditure per Week During Pregnancy According to Body Weight at Start of Pregnancy

<table>
<thead>
<tr>
<th>Weight of Woman at Start of Pregnancy (lb)</th>
<th>Minimum Energy Expenditure of 16 MET-h/wk</th>
<th>Target Energy Expenditure of 28 MET-h/wk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Calories/Wk</td>
<td>Light (h/wk)</td>
</tr>
<tr>
<td>100</td>
<td>759</td>
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</tr>
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<td>911</td>
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</tr>
<tr>
<td>320</td>
<td>2,428</td>
<td>6.4</td>
</tr>
</tbody>
</table>

MET, metabolic equivalent task; Light, approximate number of h/wk walking (2.0 mph, 2.5 METs); Vigorous, approximate number of h/wk bicycling on a stationary bike (6.0 METs).

The oxygen requirement for certain physical activities are as follows: walking 2.0 mph (3.2 km/h)=2.5 METs; conditioning exercise, calisthenics (light to moderate)=3.5 METs; walking 3.5 mph (5.6 km/hr)=3.8 METs; swimming, general leisure=6.0 METs; bicycling 10.0 to 11.9 mph (19.3 to 22.4 km/h) or stationary=6 to 7 METs (adapted from Warburton et al.

For the light physical activity option, the rating of perceived exertion is suggested to be 12–14. For the vigorous physical activity option, the rating of perceived exertion is suggested to be 15–16. These recommendations are for individuals without medical and obstetric complications. Complications are listed elsewhere.

### Light Strength Training Does Not Negatively Affect the Newborn's Body Size and Overall Health

In a randomized controlled trial of 160 women, 80 sedentary pregnant women performed light resistance exercise training three times a week for 35 to 40 minutes per session during the second and third trimesters. Ten to 12 repetitions of various muscular strengthening exercises were completed using light weights (3 kg or less) or resistance bands. Whole-body, large muscle group exercises were used (eg, knee extensions, hamstring curls, abdominal sit-ups, bench press, bicep curls). Compared with a control group, newborns birth weight did not differ significantly, and those in the strength-training group gained less weight. Box 1 provides light-resistance training guidelines should pregnant women wish to supplement aerobic exercise with strength training.

The potential risks of exercise to the woman and fetus during pregnancy have been evaluated. Some of these risks include cardiac risks of exercise, small for gestational age fetuses, and abnormal fetal heart rate response. The most recent research demonstrates that these risks are minimal compared with the benefits gained from regular physical activity. The recommendations in Table 1 and Box 1 are provided for use by pregnant women.
REFERENCES


Box 1. Safety Guidelines During Pregnancy: Muscle Strengthening

For pregnant adults aged 18 to 45 years of age, 8 to 10 muscular strength exercises can be performed for one to two sessions per week on nonconsecutive days. One aerobic training session can be replaced by a muscle strengthening session in the weight room or at home.

Use lighter weights and more repetitions. Heavy weights may overload joints already loosened by increased levels of the hormone relaxin during pregnancy. For example, if one usually performs leg presses with 35 lb for 8 to 12 repetitions, try 20 lb for 15 to 20 reps. Or, if one typically performs a chest press with 15 lb for 8 to 12 repetitions, try 8 lb for 15 to 20 reps.

Try to avoid walking lunges. These may raise the risk of injury to connective tissue in the pelvic area.

Be careful with free weights because they may involve the risk of hitting the abdomen. Women can use resistance bands instead, which offer different amounts of resistance and varied ways to do weight training and should pose minimal risk to the abdomen.

Try not to lift while flat on your back. In the second and third trimesters, lying on your back may cause the uterus to compress a major vein, the inferior vena cava, into which blood from the pregnant uterus flows. This increased pressure can be transmitted to the placenta and could compromise fetal blood flow in the gas-exchange area, thereby limiting oxygen supply to the fetus. An easy modification is to tilt the bench to an incline.

Try to avoid the valsala maneuver. This maneuver, forcefully exhaling without actually releasing air, can result in a rapid increase in blood pressure and intra-abdominal pressure and may decrease oxygen flow to the fetus. Also, on rare occasions, the uterus can be displaced against the inferior vena cava, which can result in a decrease in blood pressure. Thus, a decrease in blood pressure also can occur with the valsala maneuver during pregnancy, but this is uncommon.

Listen to your body. The most important rule is to pay attention to what is going on physically. If you feel muscle strain or excessive fatigue, modify the moves and reduce the frequency of the workouts. Pregnancy is not the time to perform heavy weightlifting, but muscle strengthening according to these guidelines will burn calories and increase the resting metabolic rate.