

# Benefits of Exercise During Pregnancy

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**Abstract:** There is a direct link between healthy mothers and healthy infants. Exercise and appropriate nutrition are important contributors to maternal physical and psychological health. The benefits and potential risks of exercise during pregnancy have gained even more attention, with a number of studies having been published after the 2002 American College of Obstetrics and Gynecologists guidelines. A review of the literature was conducted by using PubMed, Scopus, and Embase to assess the literature regarding the benefits of exercise during pregnancy. The search revealed 219 publications, which the authors then narrowed to 125 publications. The purpose of this review is to briefly summarize the known benefits of exercise to the mother, fetus, and newborn.

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## INTRODUCTION

The American College of Obstetrics and Gynecologists recommends that, during pregnancy, women should perform 30 minutes or more of moderate-intensity exercise on most, if not all, days of the week [1]. Yet, many healthy pregnant women are either not advised of the benefits of exercise or choose to not participate in activity as recommended by the American College of Obstetrics and Gynecologists guidelines [2-4]. Since the 2002 publication of the American College of Obstetrics and Gynecologists guidelines, multiple researchers have reported the benefits of exercise, in a variety of formats, for the mother, fetus, and child [5-37]. Charlesworth et al [38] reported that previously inactive and active healthy women are at low risk for adverse fetal or maternal events if they participate in routine physical activity during pregnancy. However, once pregnant, women generally tend to decrease their activity levels [39,40]. Barriers to exercise reported by pregnant women include lack of motivation, perceived lack of time due to family and work demands, desire to postpone weight loss until after delivery, and pain with movement [39]. Thus, the means to motivate women to exercise during pregnancy needs to be explored. Kwolek et al [41] reported that, in a cohort of pregnant soldiers who exercised, it was the knowledge of the benefits to the fetus that motivated them to exercise. To motivate healthy pregnant women to exercise, health care providers should provide education regarding (1) the appropriate type and amount of exercise that should be undertaken during pregnancy, and (2) the benefits to the pregnant woman, the fetus, and the newborn infant. The purpose of this review is to summarize the benefits of exercise during pregnancy to the mother, infant, and child.

## METHODS

The senior author (H.P.) conducted a search by using PubMed, Embase (Elsevier, New York, NY), and Scopus (Elsevier) programs to identify studies with clinical relevance regarding the effect of exercise during pregnancy. Only original studies and systematic reviews were considered for review. The search revealed 219 publications. After a review of abstracts and articles, the search was narrowed to 86 publications. These publications were then grouped based on topic to include the effects of exercise on the following: maternal, fetal, and infant health; maternal psychological well-being; and weight management. All of the authors have research and clinical experience regarding musculoskeletal care (including exercise recommendations) for women during pregnancy and post partum.

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## TYPE OF EXERCISE

Aerobic exercise [5,7,9,11-13,15,21,24,27,28,34], progressive resistive strengthening [8,10,17,23,25,27,32], stretching exercises [36,37], yoga [6,30], and Qi [20] have all been reported to be safe to perform when pregnant. The type of aerobic exercise that has been found to be beneficial during pregnancy is quite varied. Stationary bicycling, jogging, walking, stair climbing, treadmill use, water exercise, swimming, and an aerobic dance class have all been used. The dosage of the intervention (length of participation, frequency, and duration) also can be quite varied. Reports of length of participation in exercise ranges from 12 weeks [26,27,32,33] to span an entire pregnancy [14,19,30,34,36]. The frequency of aerobic exercise participation is most commonly 3-5 times per week [30,32,34,36]. Yeo et al [36] reported that the variation of frequency of exercise was dependent on the phase of the pregnancy. The duration of aerobic exercise can range from 15 minutes up to 150 minutes per session. An aerobic exercise prescription of 60 minutes or longer has been found to be safe for mother, fetus, and infant [14,19,23,26,30,32-34,36]. The intensity of aerobic exercise can be safely monitored by using self-pacing techniques [27,28] or heart rate monitoring using 50%-75% of the age-predicted maximum [11,25,28,32]. The safe use of progressive resistive strength training in pregnancy has been reported in only a few studies [8,10,17]. Progressive resistive strength training, although commonly reported by pregnant women as part of their exercise program [37], is often combined with aerobic exercises [23,25-27,32]. Thus, it is difficult to make recommendations regarding the appropriate dose and potential benefits of isolated strength training during pregnancy. Dosage of stretching exercises has similarly not been well investigated. Yeo et al [36] used a 40-minute video that demonstrated comprehensive stretches to be preformed 5 days per week.

## BENEFITS OF EXERCISE: MATERNAL

### Fitness

Maternal benefits from exercise during pregnancy include improved cardiovascular function [11,24,25,29,42-45], a lower risk for gestational diabetes in women who are obese or not obese [17,46-48], improved strength [28] and lean muscle mass [8], improved sense of well-being [7,20,26,28,30,34], and enhanced sleep [6,49]. In addition, reductions in bone density loss [50] and physical discomfort [5-7,31] have been reported.

Specific cardiovascular function improvements due to aerobic exercise in pregnancy include decreased heart rate at rest and during exercise [42,43,48] and higher stroke volumes [29,44], increase in  $O_2$  uptake at the anaerobic threshold [32], and improved anaerobic ventilatory threshold [25]. Other positive cardiovascular improvements are increased exercise duration [12,45], increased peak power output [12], and enhanced fat versus carbohydrate oxidation [11]. Interestingly, maximum oxygen uptake  $VO_{2\max}$  does not change in response to cycling,

swimming, or other forms of aerobic exercise during pregnancy [51-57].

Besides aerobic exercise, other types of exercise have unique outcomes that may facilitate motivating pregnant women to exercise. In a single case report, progressive resistive strength training across a pregnancy resulted in an increase in lean muscle mass [8]. For women with gestational diabetes, strength training or strength training combined with diet changes were both related to a decreased need for insulin [10,17]. Unique benefits of stretching exercises include a decreased incidence of gestational hypertension and an increase in antioxidant markers at the time of delivery [36,37]. Yoga and Qi, both exercise interventions that combine some stretching with strengthening, have been reported to increase quality of life scores in pregnant women [20,30]. Water exercise has also been found to increase quality of life scores [19,36] as well as reduce lower extremity edema and decrease back pain [31]. An individualized exercise program tailored to specific muscle impairments reduced low back pain during pregnancy [27].

### Weight Management

Weight gain during pregnancy is a natural and necessary process. However, excessive gestational weight gain (EGWG) is associated with maternal complications, including cesarean delivery, hypertension, preeclampsia, impaired glucose tolerance, and gestational diabetes [58]. Studies have assessed the benefits of exercise in pregnant women with normal weight, overweight, and obesity with regard to gestational weight gain (GWG) and EGWG.

Ruchat et al [59] randomized women with normal weight at 16-20 weeks gestation to 1 of 3 groups: low-intensity exercise, moderate-intensity exercise, or control. Total GWG was higher in the control group compared with either exercise group. EGWG was prevented in 70% and 77% of the low- and moderate-intensity exercise groups, respectively. The exercise groups retained less weight 2 months post partum compared with controls. In another recent study, Hui et al [60] compared physical activity and food intake over 2 months time during pregnancy in women who engaged in group exercise, home exercise, and nutritional counseling compared with controls. The intervention group had reduced calorie and fat intakes with higher reports of physical activity ( $P < .01$ ) compared with controls. The prevalence of EGWG was significantly reduced ( $P < .01$ ) in the intervention group compared with controls. Haakstad and Bo[61] studied pregnant women with normal weight and compared a 12-week supervised exercise program with usual care. Only women who attended 24 exercise sessions demonstrated significantly less weight gain during pregnancy ( $P = .006$ ) and less postpartum weight retention ( $P < .01$ ) compared with controls. Phelan et al [62], in the Fit for Delivery Study, followed up 401 pregnant women during their pregnancy and 6 months post partum. Participants were randomized to

standard of care ( $n = 200$ ) or to the behavior intervention group ( $n = 201$ ). The intervention consisted of a face-to-face visit; weekly mailed printed material on appropriate weight gain, healthy eating, and exercise; individual graphs of weight; and telephone-based feedback. This minimal intervention compared with the standard of care decreased the percentage of women with normal weight who exceeded the recommended GWG (40.2% compared with 52.1%;  $P = .003$ ). Exceeding this limit has been associated with increased difficulty in attaining ideal weight post partum, postpartum depression, and decreased overall well-being. This intervention consisted mostly of education, a relatively inexpensive intervention with a potential for high yield.

Results of studies that involved pregnant women who were overweight and obese before pregnancy have also shown the benefits of exercise and nutritional counseling. Sui et al [63] published a systematic review to assess the harms and benefits of exercise during pregnancy. Six randomized control trials and 1 pseudorandomized controlled trial that involved a total of 276 pregnant women found that 216 of the women involved in an exercise program had lower gestational weight compared with controls. Although these effects were positive, the authors concluded that further studies are needed to assess maternal and infant general health. In a randomized control trial, Nascimento et al [64] found no difference in general health between pregnant women who were obese and overweight who participated in an exercise program starting between 14 and 24 weeks gestation compared with controls. However, the women who participated in the exercise program gained significantly less weight ( $P = .001$ ) after entering the program compared with controls. Furthermore, de Keyser et al [65] studied the effect of a weight-gain restriction program compared with usual care in pregnant women who were obese. Comparisons included GWG, mean health care costs during pregnancy, delivery, and the neonatal period. Women who restricted weight gain to 4.6-9.5 kg had the lowest costs. However, the total costs, including the intervention, was higher in the intervention group compared with usual care ( $P = .025$ ). Collectively, these studies describe the benefits of exercise during pregnancy for weight management in women who were normal weight, overweight, and obese.

## General Health and Psychological Well-Being

During pregnancy, health care providers advocate for improved generalized health and exercise. From 2001-2009, 22,604 pregnant women's healthy behaviors were tracked [66]. Over 8 years, an improved percentage of healthy behaviors occurred. In 2001, 7.3% and, in 2009, 21.2% of pregnant women did not smoke, did not consume alcoholic beverages, did engage in leisure time exercise, and did receive an influenza vaccination [66], which represents progress but is still a relatively small percentage of the pregnant population that demonstrates

healthy behaviors. A study published in 2011 [67] found that low-income African American pregnant women had a broad definition of what constitutes exercise, which ranged from household duties to running, which suggests that the definition of exercise in the general public is not well defined, and, therefore, that women may inadvertently not participate in activities that involve aerobic fitness. Further educational intervention is necessary to improve healthy behaviors, including exercise, of pregnant women.

The benefits of exercise and psychological well-being are evident for women and extend into pregnancy. In general, pregnancy is thought of as a time for emotional well-being for many women. However, results of a meta-analysis of 21 studies suggest that the mean prevalence rate for antenatal depression is 10.7%, with a range in the first trimester of 7.4% and in the third trimester of 12.8% [68]. Researchers have linked exercise to improved psychosocial well-being. Several studies [66,69-72] have investigated the effects of a regular exercise program during pregnancy. A systematic review completed in 2010 found broad literature support of the antidepressant effects of exercise in the general population, and a small number of observational studies reported that regular physical activities improve self-esteem and reduce the symptoms of anxiety and depression during pregnancy [71]. In 2012, Robledo-Colonia et al [70] published a randomized control trial of exercise during pregnancy that involved 80 nulliparous, pregnant women. The experimental group completed a 3-month supervised exercise program, whereas the control group continued usual activities with no specific exercise program. After the 3-month intervention, the women who exercised regularly had a statistically significant decrease in depressive symptoms compared with the control group [70]. A randomized control trial of postpartum depression found that, after a 12-week exercise program of both aerobic and strengthening exercises, there was no protective effect on developing postpartum depression except for a subgroup of women who did not previously exercise before pregnancy [72]. Another subgroup, pregnant adolescents, was studied by Koniak-Griffin [69]. A 6-week aerobic exercise program in pregnant adolescent women from 14 to 20 years of age had a significant decrease in depressive symptoms over time and increased total self-esteem. The control group showed a significant increase in physical discomforts associated with pregnancy [69].

Body image satisfaction during pregnancy is also an important determinant of psychological well-being. Researchers found that a healthy body image was a nonpharmacologic strategy that could offer protective effects against depressive symptoms during pregnancy [73]. Regular exercise and activity may help to achieve this goal.

## BENEFITS OF EXERCISE TO THE FETUS

Benefits to the fetus that may be used to motivate women to exercise during pregnancy include decreased resting fetal heart rate [11,13,74-76], improvement in the viability of the placenta

[9,13,14,75], and increased amniotic fluid levels [31]. Ramierz-Velez et al [77] reported an increase in endothelium-dependent vasodilation. This effect of exercise has been postulated to possibly provide protection against preeclampsia [77]. Caution is suggested at exercise intensities above 90% of heart rate maximum. In 1 study, fetal bradycardia and high umbilical artery pulsatility occurred, which indicates that intense exercise could potentially compromise fetal well-being [78].

## BENEFITS OF EXERCISE TO THE INFANT

Children of women who exercise during their pregnancy have lower birth weights [12,15,16,79], increased gestational ages [80-82], and potentially improved neurodevelopment [12,15,16,61]. Neonates of exercising mothers had a lower percentage of body fat [12,15,16,81]. This lower weight at birth was found to be correlated to changes in leptin levels late in pregnancy, which indicates that the placental response to exercise may be partially responsible for the lower weights [81]. Clapp [12] and Clapp et al [16] reported that neonates of exercising mothers who were followed-up to 5 years of age regained typical body fat and weight at 1 year of age but were leaner at age 5 years. This indicates that, as children of exercising mothers grow, they maintain a leaner body mass index compared with children of nonexercising mothers. Recently, Matran et al [79] reported that weight and height-to-weight scores of 2-year-old children born to active mothers were marginally associated with late pregnancy activity levels.

With regard to neurodevelopment of the child, there is still limited research available to use as a motivator for pregnant women. Long-term neurodevelopmental benefits for the infant due to maternal exercise during pregnancy are still unclear. Recently, Apgar scores have been found to be higher in neonates who are born to exercising mothers [61]. Clapp et al [16] reported improved orientation and the ability to self-soothe in neonates as well as higher general intelligence and oral language scores in 5 year olds.

## MOTIVATION TO EXERCISE DURING PREGNANCY

Once pregnant, women tend to decrease their activity levels [39,40]. Barriers to exercise reported by pregnant women include lack of motivation, perceived lack of time due to family and work demands, a desire to postpone weight loss until after delivery, and pain with movement [39]. Motivation to exercise during pregnancy can be enhanced if the benefits to the mother, fetus, and child are explained, and if methods to lower the barriers to exercise are used. Use of the available known benefits of exercising during pregnancy should be used as well as exploring appropriate educational methods. Reported methods to improve the process of educating women and to increase their receptivity to exercise include using an educational video [83], providing greater support across the pregnancy to facilitate

exercise [84], and providing women with a means for self-monitoring their activity level [85]. Key behavioral barriers could be addressed with a simple telephone call [84], thus providing support as gestation progresses. In addition, providing a pedometer or other form of activity log for objective means of documenting activity [85] is a simple inexpensive tool that could greatly improve the health of the mother, fetus, and child.

## SUMMARY

There is considerable evidence that exercise during healthy pregnancy has positive effects on the mother and fetus. Furthermore, there is some evidence that suggests positive effects on the child. Women, therefore, should be encouraged to initiate or continue exercise during a healthy pregnancy. Further research is required to assess the short- and long-term effects of weight management on maternal and infant health, the psychosocial benefit of exercise during pregnancy, and the effect of exercise during pregnancy on the neurodevelopment of children.

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### CME Question

An aerobic exercise prescription safe to perform when pregnant includes the following EXCEPT:

- length to span an entire pregnancy
- frequency of 3-5 times per week
- 60 minutes or greater per session
- heart rate of 85% of age predicted maximum

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