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Physical exercise during pregnancy: a systematic review

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Purpose of review

This review aims to provide an update on the recent evidence concerning exercise during pregnancy including effects for mother and fetus and the types, frequency, intensity, duration and rate of progression of exercise performed.

Recent findings

Exercises during pregnancy are associated with higher cardiorespiratory fitness, prevention of urinary incontinence and low back pain, reduced symptoms of depression, gestational weight gain control, and for cases of gestational diabetes, reduced number of women who required insulin. There is no association with reduction in birth weight or preterm birth rate. The type of exercise shows no difference on results, and its intensity should be mild or moderate for previous sedentary women and moderate to high for active women. The exercise recommendations still are based on the current guidelines on moderate-intensity, low-impact, aerobic exercise at least three times a week. Yet, new guidelines propose increasing weekly physical-activity expenditure while incorporating vigorous exercise and adding light strength training to the exercise routine of healthy pregnant women. In the case of other chronic diseases like hypertension, there are still few data, and therefore more studies should be performed to assess the safety of the intervention.

Summary

Physical exercise is beneficial for women during pregnancy and also in the postpartum period; it is not associated with risks for the newborn and can lead to changes in lifestyle that imply long-term benefits.

Keywords

maternal and perinatal outcomes, physical exercise, pregnancy

INTRODUCTION

In recent years, there has been a great increase of knowledge derived from scientific studies regarding physical exercise during pregnancy. This reflects the need to clarify the effects for mother and fetus, as some women of childbearing age report exercising and may continue their exercise practice during pregnancy, whereas other sedentary women may start this practice only during pregnancy [1]. The last *Cochrane* review regarding aerobic exercise for healthy pregnant women concluded, however, that the data are insufficient to infer risks and benefits for mother and infants. Aerobic exercise may improve or maintain physical fitness throughout pregnancy [2].

The goal of this review is to provide an update on the latest evidence concerning exercise during pregnancy including effects for mother and fetus and the type, frequency, intensity, duration and rate of progression of exercise performed.

METHODS

A systematic review of *PubMed* and the *Institute for Scientific Information (ISI) Web of Knowledge* on the

effects of physical exercise during pregnancy on maternal and fetal outcomes was performed. Databases were screened using the *Medical Subject Headings* terms ('physical exercise' or 'physical activity' and 'pregnancy' or 'gestation'). The literature search produced a total of 2368 articles, with 359 from *PubMed* and 2009 from ISI. After limiting the search to allow for inclusion criteria (only randomized controlled trials conducted in healthy pregnant women, who underwent any form of physical exercise program with maternal or fetal outcomes being assessed, published in the last 2 years – from July 2010 to July 2012 – and in English), a total of 184 potential articles remained for analysis. Two independent reviewers carried out the selection

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KEY POINTS

- Pregnancy represents a special state in which women are often highly motivated to implement behavioral changes. Starting exercises during pregnancy could change the lifestyle of the woman with long-term positive impact.
- Exercise is safe for mother and fetus and should be indicated to all pregnant women in the absence of absolute contraindications.
- Exercise practice during pregnancy is associated with the control of gestational weight gain, gestational diabetes, prevention of urinary incontinence and low back pain.
- All pregnant women should be encouraged to participate in aerobic and strength training at moderate-intensity sessions at least three times a week for 30 min or more.
- For pregnant women with chronic diseases (such as hypertension), more studies should be performed to certify the safety of the intervention.

and methodological evaluation of the articles. First, these articles were screened by analyzing their titles. Second, each abstract was then systematically reviewed. Third, the 29 full-text articles remaining from the previous steps, and which potentially addressed the topic, were accessed and their reference lists were also reviewed to identify additional articles. In the final analysis, 19 articles remained. We grouped the articles according to maternal and fetal outcomes (low back pain, depression, gestational weight gain, gestational diabetes, urinary incontinence, quality of life, newborn weight, gestational age at delivery, and Apgar score) (Table 1) [3–21].

PREVALENCE OF PHYSICAL EXERCISE DURING PREGNANCY

There are some studies in different countries on the prevalence and characteristics of exercise among pregnant women. Regarding the levels of physical activity among pregnant women in the United States, one study reported that only 15.8% of women are engaged in exercise during pregnancy at the recommended level [22]. An assessment of levels of physical activity in a cohort of healthy women in Ireland, who had no contraindications to exercise during pregnancy, found that only 21.5% women met the current recommendations for exercise in pregnancy [23]. Danish nulliparous women in general decreased the intensity and time spent on exercise during pregnancy in relation to prepregnancy. The proportion of women who took

part in competitive sports, and moderate-to-heavy activities decreased over the three trimesters of pregnancy, whereas the proportion of women with sedentary activity increased from 6 to 29% [24].

In another study conducted with British pregnant women, the prevalence of being engaged in physical activity that was sufficient to cause sweating for 3 h/week or more was 48.8% at 18 weeks of gestation and was similar at 32 weeks [25].

In Brazil, alarming data concerning sedentary lifestyles during pregnancy was found in which only 4.7% of pregnant women are active during the whole pregnancy, and 12.9% of women reported to engage in some type of physical activity during pregnancy [26]. We observed that the prevalence of active pregnant women, as well as duration, frequency and intensity of their exercise, are lower than that of adult women and exercise is practiced at an insufficient level to assure the benefits of an active lifestyle [22,26].

PHYSICAL EXERCISE PRESCRIPTIONS/ GUIDELINES FOR PREGNANT WOMEN

As the effects of healthy lifestyle are well known and supported by studies that show it is safe for both mother and fetus, physical exercise is a recommended activity for pregnant women. The American College of Obstetricians and Gynecologists [27] recommends that all healthy pregnant women follow the American College of Sports Medicine-Centers for Disease Control and Prevention's general guidelines for physical exercise by engaging in 30 min or more of moderate physical activity per day in the majority or preferably all days of the week [28]. Women who were active before pregnancy may continue their activities, but change intensity and frequency over the course of pregnancy [27,28].

Other guidelines for physical exercise during pregnancy and the postpartum period have been published, such as the Canadian guidelines for exercise during pregnancy in 2003 [29], and the recommendations of the Royal College of Obstetricians and Gynaecologists in 2006 [30]. Some researchers argue for the necessity of incorporating strength training and muscle conditioning, revising the definition of moderate exercise, and increasing the amount of vigorous intensity exercises and weekly physical activity expenditure [31].

TYPE OF EXERCISE

Aerobic exercise is recommended to maintain cardiovascular fitness and to help prevent chronic diseases, apart from avoiding excessive weight gain. It should involve large muscle groups in activities

Table 1. Summary of randomized clinical trials that assessed the effect of maternal and perinatal outcomes published between 2010 and 2012

Authors	Study design	Sample size	Outcome	Exercise intervention	Results
Stafne <i>et al.</i> [3]	Two-arm, two-center, RCT	855 pregnant women	Lumbopelvic pain prevalence at 36 week	12 week of aerobic and strengthening exercises (20–36 week). One supervised and twice home exercise	No difference prevalence lumbopelvic pain at 36 week (74 vs. 75%, $P=0.76$). Lower women sick leave due pain (22 vs. 31%, $P=0.01$)
Kluge <i>et al.</i> [4]	RCT	26 vs. 24 controls with back pain (16 and 24 week)	Low back pain intensity and functional ability	10-week exercise program	Improvement in pain intensity ($P<0.01$) and functional ability ($P=0.06$) in study group
Robledo-Colonia <i>et al.</i> [5]	RCT with concealed allocation, blinded assessors	80 nulliparous women (16–20 week)	Symptoms of depression (CES-D) at baseline and after 3 months of intervention	3 months supervised exercise (walking, aerobic, stretching, and relaxation)	Reduced depressive symptoms in experimental group by 4 points (95% CI 1–7)
Songoygard <i>et al.</i> [6]	RCT	379 vs. 340 controls pregnant women	Postnatal depression (EPDS) 3 months postpartum	12-week aerobic and strengthening exercises (20–36 week). One supervised and twice home exercise	No difference between groups. Women did not exercise prior pregnancy had a reduced risk ($P=0.03$)
Hui <i>et al.</i> [7]	RCT	102 vs. 88 controls Nondiabetic pregnant women (<26 week)	EGWG	Community-based group exercise, instructed home exercise	Higher physical activity after 2 months of intervention. Reduced EGWG ($P=0.01$)
Nascimento <i>et al.</i> [8]	RCT	40 vs. 42 controls (14–24 week)	GWG, blood pressure, perinatal outcome and QOL	40 min of exercise (light/moderate intensity, stretching, muscle conditioning, and relaxation) once a week under supervision and home exercise counseling	No difference excessive GWG (47 vs. 57%). Overweight pregnant women gained less weight ($P=0.001$). There was no difference in blood pressure, perinatal outcome, and QOL
Haakstad and Bø [9]	RCT	52 vs. 53 controls sedentary, nulliparous women	EGWG	12 week, twice/week 1-h fitness class	Regular exercise reduces EGWG rates ($P=0.006$) and postpartum weight retention ($P<0.01$)
Phelan <i>et al.</i> [10]	RCT, assessor blinded	200 vs. 201 controls pregnant (13.5 week)	EGWG	Behavioral intervention (face to face, visit, material about healthy eating and exercise, weight gain)	Reduced EGWG in NW women and prevented postpartum weight retention in NW and OW/OB women
Stafne <i>et al.</i> [11]	RCT	855 gestational week (18–22 week)	Gestational diabetes and insulin resistance	Moderate-high intensity standard exercise 3 or more days/week	No difference between groups. Low adherence

Table 1 (Continued)

Authors	Study design	Sample size	Outcome	Exercise intervention	Results
Barakat <i>et al.</i> [12]	RCT	40 vs. 43 controls	Maternal glucose tolerance and prevalence of GD	Land/aquatic activities, 3 times a week during entire pregnancy	Improves level of maternal glucose tolerance ($P=0.000$). No difference on GD prevalence and weight gain
De Barros <i>et al.</i> [13]	RCT	32 vs. 32 controls, pregnant women with gestational diabetes	Insulin requirement and glycemic control	Resistance exercise with elastic band	Reduced the number of women who required insulin ($P=0.005$) an improving glycemic control ($P=0.006$)
Ko <i>et al.</i> [14]	RCT	300 pregnant women	Urinary symptoms – urinary incontinence	PFM exercise	Lower scores IIQ-7 and IDI-6 and urinary incontinence symptom during pregnancy and postpartum
Mason <i>et al.</i> [15]	RCT	141 vs. 145 controls pregnant women	Urinary symptoms – stress incontinence	4 classes of taught PFM and 8–12 maximal contractions twice daily at home	No difference (Bristol and Leicester questionnaires, three day diary at 20 and 36 week and 3 months postpartum)
Bo and Haakstad [16]	Single-blind RCT	52 vs. 53 controls sedentary primiparous women	Number of women reporting urinary, flatus or anal incontinence	12 week, twice/week 1-h fitness class (three sets of 8–12 PFM contractions)	No difference. Low adherence
Ramírez-Vélez <i>et al.</i> [17]	Double-blinded RCT	64 healthy primigravid women (16–20 week)	Endothelial function and cardiorespiratory fitness	16 week of aerobics exercise (50–65% maximum heart rate), 3 times a week	Higher cardiorespiratory fitness by 6-min walk test ($P=0.01$), VO_2 max ($P=0.01$), lower heart rate at rest and higher flow mediate dilatation ($P=0.02$)
Barakat <i>et al.</i> [18]	RCT	34 vs. 33 controls sedentary pregnant women (6–9 week)	Maternal perception of health status, weight gain, urinary incontinence, pregnancy and neonatal outcomes	Physical conditioning (35–45 min 3 times a week – walking, light stretching, resistance exercise, PFM exercise)	Maternal health perception ($P=0.03$), weight gain ($P=0.03$). No difference in others pregnancy outcomes. Birth weight and Apgar scores
Montoya Arizaboleta <i>et al.</i> [20]	RCT	64 nulliparous pregnant women (16–20 week)	Health-related QOL	3 months exercise program (walking, aerobics, stretching, and relaxation)	Improves health-related QOL [physical component summary by 6 points (95% CI 2–11), physical function, bodily pain, and general health (5 points, 95% 1–10)]

Table 1 (Continued)

Authors	Study design	Sample size	Outcome	Exercise intervention	Results
Valim <i>et al.</i> [19]	RCT	31 vs. 35 controls low-risk pregnant women (≤ 20 week)	QOL (WHOGOL-BREF), experience with pregnancy and prenatal care	3 aerobics classes/week	No association between the water aerobics practice and QOL. Women considered exercise had benefited them in some way
Haakstad and Bo [21]	RCT	52 vs. 53 controls sedentary, nulliparous women	Birth weight	12 week of aerobic dance and strength training, 60 min, twice/week	Aerobic-dance was not associated with reduction in birth weight. Preterm birth or neonatal well being

CES-D, Center for Epidemiological Studies Depression Scale; CI, confidence interval; GD, gestational diabetes; EGWG, excessive gestational weight gain; EPDS, Edinburgh Postnatal Depression Scale; GWG, gestational weight gain; IDI-6, urogenital distress inventory; ILQ-7, Incontinence Impact Questionnaire; NW, normal weight; OW/OB, overweight and obese; PFM, pelvic floor muscle; QOL, quality of life; RCT, randomized clinical trial; WHOGOL-BREF, the World Health Organization abbreviated quality of life questionnaire.

such as walking or jogging, using stationary bicycle, treadmill, swimming, water aerobics exercises, aerobic dance, or low-impact aerobics [27,29,30]. Regardless of the choice of activity, it is important that women find a modality of exercise to which they will adhere over the long term. Those exercises that increase the risk of falling, abdominal traumas and contact sports should be contraindicated [27,29,30].

Recent recommendations add strength training to the routine exercise of pregnant women. They suggest that light strength training during second and third trimesters does not affect newborn size or overall health. Strength training for pregnant women can be performed once or twice per week on nonconsecutive days, with 8 to 10 strength exercises per session [32]. These effects have been rarely studied, although many women looking for muscle conditioning during pregnancy think that practices such as Pilates, yoga, circuit-type resistance training, and weight training could be beneficial. The possible benefits of increasing strength and stretching training are improvement in overall body strength, good posture and body core strengthening that may contribute in labor, birth, and prevent musculoskeletal discomforts [33]. Nevertheless, it should be recommended to be careful with over-exertion and overstretch to minimize risk of injury to connective or muscle tissues. It is preferable that pregnant women engage in activities they were used to before pregnancy. In addition, pelvic floor muscle strengthening is also an important component in pregnant women's exercise. It seems that the more intensive the programme the greater the treatment effect. Pelvic floor muscle exercises should be added to the exercise routine of pregnant and postpartum women [34].

Attention should also be paid in avoiding exercise in supine position during the second half of pregnancy in order to prevent hypotension and avoid the Valsalva maneuver throughout the pregnancy [29].

INTENSITY OF EXERCISE

The impact of exercise and physical activity on the cardiovascular system varies according to the type, duration, and level of intensity. Assessment of physical activity intensity may be performed by measuring the variation in heart rate (HR) increase with exertion compared with the HR at rest or to maximum HR (or peak rate). As a result of cardiorespiratory adaptations, the maximal HR reserve is reduced, so the target zones for aerobic exercise are proposed for each age decade ($<20 = 140-155$; $20-29 = 135-150$; $30-39 = 130-145$; $\geq 40 = 125-140$ beats/min) that corresponds

to around 60–80% of aerobic capacity [35]. For overweight and obese pregnant women aged 20–29, the target zone is 110–131 beats/min, and for 30–39, the target zone is 108–127 beats/min, respectively [36]. Similarly ratings of perception exertion can be used to assure an ideal intensity of exercise [37]. This scale rates from 6 to 20, and an ideal target zone for pregnant women is 12–14 that represents exercise that is ‘somewhat hard’ [35]. In the absence of these resources, the ‘talk test’ may be done (exercising at comfortable intensity that allows one to keep up a conversation) to confirm that intensity of exercise is adequate and women are not overexerting [30].

FREQUENCY OF EXERCISE AND RATE OF PROGRESSION

Previously sedentary women should start with 15 min of exercise three times a week and gradually increase to 30 min four times a week at low-to-moderate intensity. Active women may keep their routine exercise or perform at least moderate-to-vigorous exercise four times a week in sessions of 30 min or more. Athletes or women who have higher fitness status should be evaluated individually. Some high-impact activities or sports with fall or trauma risks should be avoided, and the intensity of exercise like running should be reduced. For all, brief warm-up and cool-down periods should be incorporated to each session of exercise [27,29,30,35].

PHYSICAL EXERCISE ON MATERNAL OUTCOME

The scientific literature in the last 2 years shows a variety of studies on exercise during pregnancy. Some clinical trials have been conducted to evaluate the effect of exercise on maternal outcome such as low back/pelvic pain [3,4], depression during pregnancy and postpartum [5,6], gestational weight gain and excessive weight gain [7–10], gestational diabetes and insulin resistance [11–13], urinary incontinence symptoms [14–16], cardiovascular fitness [17], and the impact of exercise on quality of life and health status perception [8,18–20] (Table 1).

Musculoskeletal discomforts such as lower back, pelvic, and/or joint pain are common complaints during pregnancy associated with the anatomical adaptations during pregnancy and previous risk factors [33]. A study developed in a South African population verified that a 10-week exercise program decreased back pain intensity and increased functional ability during pregnancy [4]. In the same direction, A *Cochrane* review shows that specifically tailored strengthening exercise, sitting pelvic tilt

exercise programs, physiotherapy interventions, and water gymnastics, all had beneficial, although small, effects when compared with standard prenatal care [33]. Stafne *et al.* [3] found no difference in the prevalence of lumbopelvic pain at 36 weeks in pregnant women submitted to 12 weeks of aerobics and strengthening exercise compared with controls. However, active women were able to better handle the condition. Musculoskeletal pain can also be attenuated with physical activity in some women who present mild pelvic and lumbar discomfort [33].

During and after pregnancy, anatomical changes and birth trauma could lead to high rate of stress urinary incontinence that was focused in three studies [34]. Previous studies showed that pelvic floor muscle exercises were effective in treating stress incontinence, however, whether antenatal pelvic floor muscle exercise could prevent incontinence during pregnancy and postpartum period still remains uncertain [14–16]. Regularly performed and specific exercises were more effective than general exercises and home exercise counseling [16]. Probably the best way to prevent incontinence related to the gestational period is to motivate pregnant women to exercise pelvic floor muscles every day following a vaginal assessment of correct contraction [15].

Obesity and obesity-associated comorbidities are great health problems worldwide including women of childbearing age. The excessive weight gain and retention of weight after birth, both increase the risk of obesity, gestational diabetes, and pregnancy-induced hypertension [38].

It seems to be the consensus that physical exercise prevents excessive weight gain [7–10]. There are three important aspects to note. First, supervised exercise programs are more effective than home exercise counseling [8,9]. Women that exercise frequently, for instance in Haakstad and Bo’s [9] study, those attending 24 sessions, have a lower mean weight gain and lower postpartum retention. Second, women with higher BMI prior to pregnancy are resistant to achieving the target weight gain according to the Institute of Medicine [8,10]. Third, the combination of exercise and dietary intervention is the best way to control weight gain [7,8,10].

In addition, physical exercise is an adjuvant intervention recommended for gestational diabetes control [39]. Three studies evaluated the effect of a variety of exercise programs on gestational diabetes [11–13]. Two of them submitted healthy pregnant women to an exercise program and showed contradictory results [11,12]. The largest study involving 855 patients found no evidence that 12 weeks of standard exercise prevents gestational diabetes or improves insulin resistance [11], whereas Barakat

et al. [12] showed that moderate physical exercise performed during the entire pregnancy improved levels of maternal glucose tolerance (50 g maternal glucose screen 24–28 weeks) with no cases of gestational diabetes. Furthermore, resistance exercise in patients with gestational diabetes was effective in reducing the number of women who required insulin and in improving glycemic control [13].

Physical exercise could prevent preeclampsia as hypothesized in recent reviews and observational studies, even though no recent clinical trial was included in these reviews [40,41*].

Equally important, the psychological impact of exercise had been studied. Clinical trials find positive effects of physical exercise on depressive symptoms during pregnancy and postpartum [5,6], quality of life, mainly with regards to physical and pain components [8,19,20], and maternal perception of health status [18]. Women who exercise during pregnancy related that this practice had benefitted them in some way [19].

PHYSICAL EXERCISE ON NEONATAL OUTCOME

The gestational period is a time of growth, development, and physiological changes in mother and fetus [42**]. Two recent studies focused the role of exercise on birth weight, gestational age at delivery, and Apgar score [8,21]. Aerobic dance exercise and strength twice a week, performed by sedentary pregnant women for a minimum 12 weeks were not associated with reduction in birth weight, preterm birth rate, or neonatal well being measured with Apgar score [21]. In agreement, neonatal outcomes of overweight and obese pregnant women who exercised at a light-moderate intensity once a week under supervision and who received home exercise counseling were not affected, despite higher rates of large for gestational age newborns in this population [8].

These results mean that physical exercise does not harm the fetus [8,18,21]. In addition, a recent review shows that children born to obese mothers or those who have gained excessive weight, have an increased risk of obesity themselves; then maternal nutrition and/or physical activity may induce beneficial physiological alterations in the fetus that are mediated through favorable adaptations to the in-utero environment avoiding maintenance of the obesity cycle [42**].

CONCLUSION

Considering the results found, we believe that the evidence is sufficient to support current recommendations for exercise during uncomplicated pregnancies. It is clear that exercise

provides benefits for maternal health and quality of life, preventing musculoskeletal discomfort, weight gain, and favoring gestational diabetes control, without leading to harms or risks for the fetus and may also have a positive effect on fetal growth and fetal adaptation.

For the group of women with pathological conditions, such as hypertension, there are still important knowledge gaps that deserve special attention in further studies on the subject.

It is noteworthy that in most countries, exercise practice is below the recommended level, so the prenatal team should be familiar with exercise recommendations and promote conditions conducive to its practice, taking advantage of this time of gestation to encourage women to begin an active lifestyle that could impact on long-term health and quality-of-life improvements.

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Conflicts of interest

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REFERENCES AND RECOMMENDED READING

Papers of particular interest, published within the annual period of review, have been highlighted as:

- of special interest
- of outstanding interest

Additional references related to this topic can also be found in the Current World Literature section in this issue (pp. 471–472).

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