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Resistance Exercise in Pregnancy and Outcome

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Abstract: As the health benefits of exercise are increasingly recognized, the traditional advice to rest during pregnancy has changed toward a more healthy and active pregnancy, therefore different forms of exercise have been integrated into the life of the pregnant woman. Although the benefits of using a combination of resistance and aerobic exercises are not yet determined, studies about resistance and strengthen training programs are few although no adverse outcomes were reported.
Key words: pregnancy, exercise, resistance, aerobic, outcomes

Introduction

Modern popular culture has embraced the concept of a "fit pregnancy," as demonstrated by the plethora of publications available on this topic.[1] As the health benefits of exercise are increasingly recognized, more women are participating in physical activity.[2] In fact currently physical activity is an important part of different populations including pregnant women. Pregnant women are encouraged to include exercise as part of a healthy lifestyle.[3]

On the basis of research over the past 30 years, current guidelines published by the American College of Obstetricians and Gynecologists, as well as other national organizations such as the Society of Obstetricians and Gynaecologists of Canada, recommend or suggest physical activity for pregnant women.[1,2] Indeed women who are pregnant and healthy are recommended to do 30 minutes or more of light to moderate exercise a day on most, if not all, days of the week.[2,4]

The process of pregnancy and childbirth is the only human situation in which all organs and systems of the female body are modified to promote fetal growth and development[5] (Fig. 1), this continual adjustment generates a significant increased risk of complications of physiological factors.[6–8] Thus, the question about the appropriate physical exercise that helps pregnant women face these changes without adverse outcomes remains unknown.

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Consensus in the scientific literature seems to be that moderate exercise during pregnancy promotes benefits for mother and fetus without risk to the well-being of both.[9] Recent studies show physical exercise as improving the quality of life of women, both in healthy pregnancies[10,11] and those with complications, such as gestational diabetes,[12–16] including psychological aspects.[17]

However, when the type and intensity of exercise are analyzed, findings are inconclusive, possibly due to the variety of study designs used (experimental, observational, case-control) and especially for the kind of intervention proposed in the experimental studies (aerobic exercise, resistance exercise, water activities, etc.) as well as the intensity of the physical load.[2,18]

Traditional medical advice has been for exercising women to reduce their habitual levels of exertion in pregnancy and for nonexercising women to refrain from initiating strenuous exercise programs.[18] This recommendation was based on concerns that exercise could affect early and late pregnancy outcomes, especially by increasing core body temperature during embryogenesis period, increasing the risk of congenital anomalies, and shifting oxygenated blood and energy substrates to maternal skeletal muscle away from the developing fetus, leading to adverse effects in growth.[19–22]

Currently, however, up to 20% of healthy pregnant women meet minimum exercise recommendations during pregnancy, that is, 20 to 30 min + /d of moderate-vigorous activities (eg, walking/brisk-walking, swimming).[23] Determining the influence of exercise type on pregnancy outcomes will help to clarify the chances of pregnant women incorporating physical exercise in their normal life. The objective of this narrative review of previous studies was to examine the influence of each, resistance or combined (resistance + aerobic) exercise programs, on maternal and fetal pregnancy outcomes.

Materials and Methods

We conducted a MEDLINE (PubMed) search (with no restriction on initial date) until July 2015. Inclusion criteria were as follows: randomized controlled trial (RCT) studies evaluating the effect of exercise performed only during pregnancy on maternal and fetal perinatal outcomes as main or secondary outcomes; conducted with healthy pregnant women; and written in English. Studies with exercise counseling and unsupervised exercises were excluded, Figure 2 shows the flow chart of data collection.

PREGNANCY OUTCOMES ANALYZED

Maternal: gestational age, type of delivery, weight gain.

Newborn: birthweight, Apgar Scores, birth length.

The search strategy was as follows (elements and terms):

(i) Search: we combined the term pregnancy outcomes with different types of exercise:
   (a) Search: pregnancy outcomes AND resistance exercise. Results: 51.
   (b) Search: pregnancy outcomes AND strength training. Results: 56.
   (c) Search: pregnancy outcomes AND aerobic exercise. Results: 1033.

(ii) Search: we combined the terms gestational age/type of delivery/maternal weight gain with different types of exercise (resistance/strengthening/aerobic).

(iii) Search: we have combined the terms birth weight/Apgar Scores/birth length with different types of exercise (resistance/strengthening/aerobic).

After analyses, studies with intervention by resistance/strengthening training[24–28] or combining resistance + aerobic exercise[7,11,17,29–47] were included, therefore depending on the type of exercise 2 groups were established:

- Resistance/strengthening training: 5.
- Combined (resistance/strengthening + aerobic) exercise: 22.

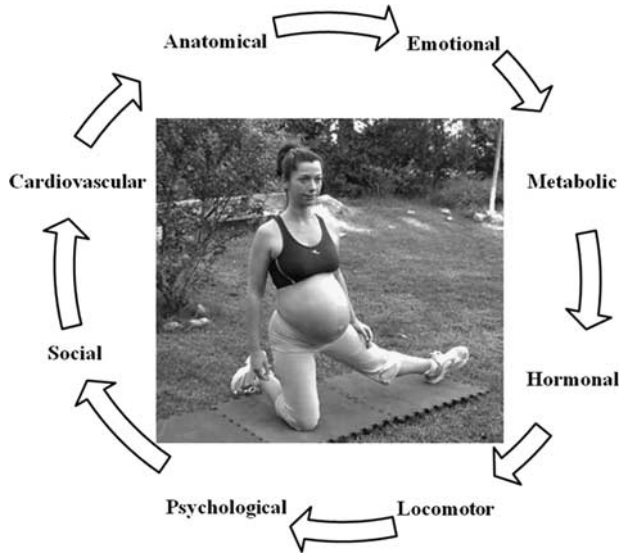

FIGURE 1. Adaptations and alterations generated by pregnancy.

The data collected from each paper included: authors and sample size, intervention type, duration of the intervention, main variable, and main results (Table 1).

Results

For presentation of the results we individualized those studies in which resistance/strengthening exercises were used. In combined studies (resistance/strengthening + aerobic) general information was reported.

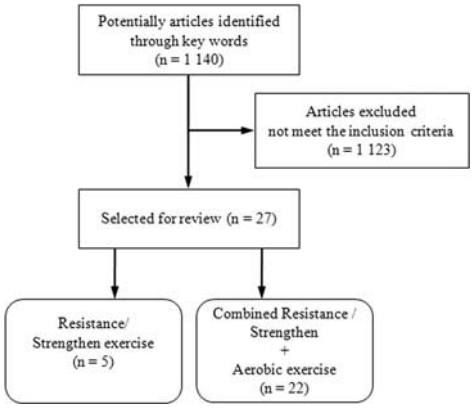

FIGURE 2. Flow chart of data collection.

RESISTANCE/STRENGTHENING EXERCISE

Barakat et al[24–26] present 3 RCTs that used a program of around 80% of age-predicted HRmax, with toning and very light resistance exercises (1 set of 10 to 12 reps) (3 kg/exercise) or low-to-medium resistance bands. The control group (CG) received usual care. They reported no effects on maternal and newborn outcomes between the study groups.

Garshasbi and Faghih Zadeh[27] present a RCT examining the effect of exercise during pregnancy on the intensity of low back pain and kinematics of the spine. The main objective of the intervention was to examine the efficacy of a strengthen exercise program on different muscle areas (hamstrings, iliopsoas, and para-vertebral muscles). The authors found no differences in maternal or newborn results.

In a study by Petrov et al[28] the Exercise Group (EG) performed high-repetition,

TABLE 1. Description of Analyzed Studies

References	Type of Intervention	Sample	Duration of Intervention	Main Variable	Main Results
Barakat et al[24]	Resistance/strengthen	EG n = 70 CG n = 72	From wk 12-13 to 38-39	GA	No effects
Barakat et al[25]	Resistance/strengthen	EG n = 70 CG n = 72	From wk 12-13 to 38-39	TD	No effects
Barakat et al[26]	Resistance/strengthen	EG n = 70 CG n = 72	From wk 12-13 to 38-39	Maternal anemia	No effects
Garshasbi et al[27]	Resistance/strengthen	EG n = 107 CG n = 105	Second half of pregnancy	Birth weight GA	No effects
Petrov et al[28]	Resistance/strengthen	EG n = 34 CG n = 38	From wk 14 to 25	Birth weight/birth length GA	No effects
Barakat et al[29]	Resistance/ strengthen + aerobic exercises	EG n = 34 CG n = 33	From wk 6-9 to 38-39	Maternal health perception	> Health perception in EG vs. CG < GWG in EG vs. CG
Barakat et al[30]	Resistance/ strengthen + aerobic exercises	EG n = 138 CG n = 152	From wk 6-9 to 38-39	TD	< CSs and instrumental deliveries in EG vs. CG < GWG in EG vs. CG
Barakat et al[7]	Resistance/ strengthen + aerobic exercises	EG n = 107 CG n = 93	From wk 9-13 to 39-40	GA, TD, GWG, BW, AS, BL	< No. women in EG exceeding the IOM recommendations
Hui et al[31]	Resistance/ strengthen + aerobic exercises	EG n = 102 CG n = 88	From wk 20-26 to 36	GWG GDM CS	< No. women in EG exceeding the IOM recommendations vs. CG
Murtezani et al[32]	Resistance/ strengthen + aerobic exercises	EG n = 30 CG n = 33	From wk 14-10 to 36-38	GA BW BL AS	> Apgar Scores at 1 and 5 min in EG vs CG
Nascimento et al[33]	Resistance/ strengthen + aerobic exercises	EG n = 39 CG n = 41	From wk 9 to 16	TD GWG BP	No effects
Oostdam et al[34]	Resistance/ strengthen + aerobic exercises	EG n = 49 CG n = 52	Before wk 20 until delivery	Fasting blood glucose levels Fasting insulin BMI Caesarean section	No effects
Pelaez et al[35]	Resistance/ strengthen + aerobic exercises	EG n = 63 CG n = 89	From wk 14 to 36	Prevention of urinary incontinence	< Incidence of urinary incontinence in EG vs. CG. < Amount of leakage in EG vs. CG
Pinzon et al[36]	Resistance/ strengthen + aerobic exercises	EG n = 31 CG n = 33	From wk 16-20 to 32-36	GWG BP TD	No effects
Price et al[37]	Resistance/ strengthen + aerobic exercises	EG n = 31 CG n = 31	From wk 12-14 to wk 36-delivery	Aerobic fitness Muscle strength GWG BP Incidence of GDM Incidence of hypertension TD	> CRF in EG at wk 30-32 vs. CG. Muscle strength in EG after 6 wk of exercise and this effect remains up to 6 wk postpartum. > Muscle strength in EG vs. CG > No. vaginal deliveries in EG vs. CG.
Salvesen et al[38]	Resistance/ strengthen + aerobic exercises	EG n = 427 CG n = 426	From wk 3-20 to 36	Incidence of GDM Duration of labor GWG CS	No effects
Santos[39]		EG n = 37 CG n = 35	From enrollment to delivery	Functional capacity Cesarean delivery	Oxygen uptake in EG ↓ Oxygen uptake in CG

TABLE 1. (Continued)

References	Type of Intervention	Sample	Duration of Intervention	Main Variable	Main Results
	Resistance/ strengthen + aerobic exercises			Hypertension Pre-eclampsia GDM	
Vinter et al[40]	Resistance/ strengthen + aerobic exercises	EG n = 150 CG n = 154	From wk 10-14 to 35	GWG Preeclampsia Hypertension CS	< No. women in EG exceed the IOM recommendations. < GWG in EG vs. CG > BW in EG vs CG
Barakat et al[41]	Resistance/ strengthen + aerobic exercises	GE n = 40 GC n = 43	From wk 6-9 to 38-39	Maternal glucose screen GWG Cases of GDM BP TD	< Values of 50 g maternal glucose screen in EG vs. CG
Barakat et al[42]	Resistance/ strengthen + aerobic exercises	EG n = 210 CG n = 218	From wk 10-12 to 38- 39	OGTT Cases of GDM GWG Caesarean deliveries	< GDM-related risk of cesarean in EG by 34% < GWG in EG by 12%
Haakstad and Bo[43]	Resistance/ strengthen + aerobic exercises	EG n = 52 CG n = 53	From wk 12-24 to 36-38	GWG Skinfold thickness Postpartum weight retention Pelvic girdle and low back pain	Women who attended 100% of exercise sessions gained less weight, did not exceed weight recommendation, and had lower postpartum weight retention than CG
Perales et al[44]	Resistance/ strengthen + aerobic exercises	EG n = 83 CG n = 83	From wk 9-11 to 39-40	Duration of labor and its stages TD GWG	Shorter 1st stage of labor in EG vs. CG. < No. women in EG exceeding the IOM recommendations
Perales et al[17]	Resistance/ strengthen + aerobic exercises	EG n = 90 CG n = 77	From wk 9-11 to 39-40	Level of depression GWG TD	↓ Depression symptoms in EG. < Incidence of depressed women in EG vs. CG. < Women in EG exceed the IOM recommendations.
Ruiz et al[45]	Resistance/ strengthen + aerobic exercises	EG n = 481 CG n = 481	From wk 9-10 to 38-39	GWG TD Incidence of GDM Duration stage of labor Incidence of hypertension	< GWG in EG vs. CG < No. women in EG exceed the IOM recommendations vs. CG < Risk of GDM and hypertension in EG vs. CG.
Stafne et al[46]	Resistance/ strengthen + aerobic exercises	EG n = 375 CG n = 327	From wk 20 to 36	Prevalence of GDM GWG BP TD	< Fasting insulin and insulin resistance in EG vs. CG
Stafne et al[47]	Resistance/ strengthen + aerobic exercises	EG n = 396 CG n = 365	From wk 20 to 36	Prevalence of lumbopelvic pain Disability	< Sick leave due to lumbopelvic pain in EG vs. CG
Cordero et al[11]	Resistance/ strengthen + aerobic exercises	EG n = 101 CG n = 156	From wk 10-12 to delivery	Cases of GDM Risk of GDM GWG TD	< Cases of GDM in EG vs. CG < risk of GDM in EG by 90% < No. women in EG exceeding the IOM recommendations

AS indicates Apgar Scores; BL, birth length; BMI, body mass index; BW, birth weight; CRF, cardiorespiratory fitness; CS, cesarean section; GA, gestational age; GDM, gestational diabetes mellitus; GWG, gestational weight gain; IOM, Institute of Medicine; TD, type of delivery.

resistance training using light barbells [1 to 10 lbs (0.45 to 4.5 kg)] and weight plates [2.5 to 10 lbs (1.1 to 4.5 kg)], which was carried out while listening to music in a supervised (by the research coordinator) setting. The frequency was twice a week for a duration of 12 weeks (pregnancy weeks 14 to 25). The authors showed no differences between groups for the main maternal variables studied, however significant differences between the groups were obtained for birthweight. Newborns delivered by women who underwent resistance exercise during pregnancy were significantly heavier than those born to control women ($P = 0.02$).

RESISTANCE/STRENGTHENING + AEROBIC EXERCISE

The structure of the session of the studies using aerobic in combination with resistance or strengthening exercise are based on step length, body rotations, shoulder shrugs, arm rotations/elevations, leg lateral elevations, pelvic tilts, rocks, and stretching section. In many studies a specific section of strengthen muscles of labour and pelvic floor were included.[7,11,17,29,30,32,35,38,41,42,44–47] In a study by Price et al[37] participants did step aerobics on the first day, walked as a group over adjacent hilly terrain on the second day, performed circuit training on a third day and completed the program with a brisk 30- to 60-minutes walk individually once weekly.

Treadmill walking, stair climbing, and stationary bicycling were included in some studies.[32,37] Oostdam et al's[34] program included a warm up, after which each participant completed an individualized session of 40 minutes, consisting of 1 or 2 aerobic exercises and 4 to 6 strength exercises.

Some studies included a session of aerobic dance, using choreography involving the upper and lower limbs of very low impact (no running or jumping) at moderate intensity, defined between 12 and 14 on the Borg rating scale of perceived exertion, following stretching and relaxation activities,[17,41–47] and in addition the study by Barakat and colleagues 1 weekly aquatic activities was included.[11]

Gestational Age, Type of delivery, Maternal Weight Gain

When gestational age was examined, most of the studies showed no differences between groups. Examining type of delivery showed that some authors found a decreased in cesarean section rates (or relative risk) in the intervention group,[30,37,42] while the majority reported similar results in the study groups. Apparently maternal gestational weight gain is the parameter more influenced by exercise, as many authors showed a decreased maternal weight gain or better control of excessive weight gain following the Institute of Medicine guidelines[48] in the intervention groups.[7,11,17,29–31,40,42–45]

Birth Weight, Apgar Scores, Birth Length

Vinter et al[40] showed a higher birthweight in the EG (3742 vs. 3596 g, $P = 0.039$). Murtezani et al[32] found higher Apgar Scores in the EG versus CG at 1 ($P = 0.036$) and 5 minutes ($P = 0.015$). The rest of the studies reported no differences between groups for neonatal outcomes.

Discussion

The aim of the present study was to examine the influence of each, resistance or combined (resistance + aerobic) exercise programs, on maternal and fetal pregnancy outcomes. The greatest difficulty we found was the small number of studies investigating resistance or strengthening programs on pregnancy outcomes in comparison with aerobic exercise. Possibly the traditional advice for pregnant women to rest[2,20] may be responsible for this low number of studies. However, no adverse results pertaining to

maternal and fetal/newborn well-being were found in the analyzed studies with resistance or strengthening interventions.

A greater number of interventions combining resistance/strengthening with aerobic exercises were found. Interesting results were reported regarding the maintenance and improvement of the quality of life of pregnant women without creating health risks of the newborn. From a physiological point of view, controlling excessive maternal weight gain appears to be the most beneficial effect resulting from regular exercise during pregnancy,[49] which may suggest that combining aerobic and resistance exercise into a program may be a new attractive and safe factor for exercise prescription by health professionals. Physical exercise has sufficiently demonstrated benefits to the health of the pregnant woman,[9] and important international guidelines[50] have been recently published.

As Table 1 shows, it is difficult to find a common position about the best model for programs of exercise during pregnancy. Studies have different designs with regard to the duration of the program, especially related to the beginning of the intervention as well as the structure of the sessions.

Despite differences, research lines should be continued independently (resistance, strengthen, aerobic, dance, aquatic, pelvic floor, etc.), as the authors of the present study highlight the need to find a global model of safe and attractive exercise programs throughout pregnancy.

Exercise should be an integral part of the life of the pregnant woman and should be fully recognized by all the participants involved in the process of pregnancy (pregnant population, physicians, midwives, physical activity professionals).

LIMITATIONS

The present study presents important limitations, as we have not considered some factors of the analyzed studies, such as adherence, nutritional intervention or counseling in CG.

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