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Current Women's Health Reviews, 2015, *11*, 75-87

Can Group Exercise Programs Improve Health Outcomes in Pregnant Women? A Systematic Review

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Abstract: Current scientific evidence supports the recommendation to initiate or continue the practice of physical exercise in healthy pregnant women. Group exercise programs have positive effects in improving health and well-being, as well as social support. In order to understand the scientific evidence in this field, and the outcomes in maternal health, it has generated wide interest in exploring the studies carried out with more relevant group exercise programs. The aim of this systematic review was to evaluate the available evidence on the effectiveness of group exercise programs in improving women's and newborns health outcomes during pregnancy. Three databases were used to conduct literature searches and strict inclusion and exclusion criteria were employed. Seventeen studies were selected for analysis. All studies were randomized control trials conducted with pregnant women that evaluated the effect of group exercise programs on the health outcomes of mother and newborn. Most studies followed a supervised structured exercise program including a main aerobic part, resistance training, pelvic floor training and stretching and relaxation sections. The significant effects of the programs are related with improved maternal perception of health status, lower maternal weight gain, improved levels of maternal glucose tolerance, improved aerobic fitness and muscular strength, lower frequency of urinary incontinence, improved sick leave due to lumbopelvic pain, fewer cesarean and instrumental deliveries, higher newborn Apgar score and faster postpartum recovery. Exercise and health professionals should advise pregnant women that aerobic group exercise during pregnancy improves a wide range of health outcomes for the women and newborns.

Keywords: Aerobics, group exercise, health outcomes, physical activity, pregnancy, quality of Life.

1. INTRODUCTION

1.1. Background

Physical exercise promotes an improvement in the physical fitness of people of all ages and health conditions. Pregnant women in particular demand special attention since they constitute a population with specific characteristics, requiring morphological, functional, emotional and social adjustments [1]. The growing interest of physical activity in pregnant women has been reporting improvements in the health and in consequence to normal fetal development [2]. Downs *et al.* [2] refer that current scientific evidence supports the recommendation to initiate or continue the practice of physical exercise in healthy pregnant women.

For healthy pregnant and postpartum women, physical activity and exercise are safe and effective ways of reducing adverse health risks for mother and newborn, as stated by Currie *et al*. [3], Lewis *et al.* [4] and Takito *et al.* [5], leading to an improvement in lifestyle that imply long term benefits, according to Nascimento *et al*. [6] and Kader *et al*. [7].

The increasing interest in exercise prescription for pregnant women has highlighted several questions regarding the frequency, duration, intensity and mode of physical exercise. The American Congress of Obstetricians and Gynecologists (ACOG) in conjunction with the American College of Sports Medicine (ACSM), refer a wide range of sports and fitness activities which may be prescribed, providing that exercise intensity is tailored to the ability of the practitioner [1, 8]. ACOG [8] and RCOG [9] recommend that healthy pregnant women should undertake moderate physical activity for 30 min on most days of the week. Moreover, the recent review on the guidelines for physical activity during pregnancy from around the world, by Evenson *et al.* [10], have highlighted the type, frequency and duration of the activities to perform during pregnancy.

Montoya *et al.* [11], Vallin *et al.* [12] and Barakat *et al.* [13], conducted randomized controlled trials with pregnant women, suggesting that their programs of group exercise had positive effects in improving well-being and reducing anxiety and depressive symptoms. Moreover, ACOG [8] refers that performing group exercise promotes acute and

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1875-6581/15 $58.00+.00

chronic changes that favor a more tolerable delivery and a faster recovery after childbirth, and fewer incidences of obesity, depression, type II diabetes and vascular problems. We may assume that an exercise program conducted in group sessions, promotes greater adherence and retention to the program, as well as social support, inspiring the group to keep highly motivated until the end of pregnancy. However, the difficulty in conducting ethically acceptable studies with pregnant women is translated only in few significant results.

Downs *et al.* [2] concluded that the literature about physical activity and pregnancy shows that there is sufficient empirical evidence to support the promotion of moderate-to-vigorous prenatal physical activity for maternal health benefits. The authors also refer that future interventions should be carefully designed and theoretically driven, including validated and reliable physical activity measures. Also, other authors such as Phelan [14] suggested that pregnancy is a window of opportunity to promote positive health behaviors. Researchers, health and exercise professionals should also consider the multifaceted determinants and outcomes of prenatal physical activity. These professionals should intervene to promote physical activity before, during and after pregnancy. Sui *et al*. [15] concluded that the promotion of appropriate physical activity should be implemented early in pregnancy and postpartum, in order to prevent the decline in activity. Future research should also explore the barriers and enablers to women engaging in physical activities and exercise programs during pregnancy and in the postpartum period.

A recent systematic review by Currie *et al*. [3] concluded that physical activity interventions throughout pregnancy incorporating behavior change techniques may help to reduce the decline in physical activity. However, there is a lack of high quality interventions and evidence about effectiveness. One systematic review by Takito *et al.* [5] did investigate the effectiveness of exercise during pregnancy on newborn outcomes; nevertheless, no studies were included regarding group exercise training. Nascimento *et al*. [6] performed a systematic review concerning the exercise effects for mother and fetus, as well as the type of exercise, weekly frequency, duration of each session, intensity and rate of progression of exercise. However, only three of the studies included, performed a group exercise program. One systematic review by Kader *et al*. [7] did not include any group exercise intervention. Lewis *et al.* [4] have reviewed the literature examining the effects of exercise during pregnancy on health outcomes of the mother, five years before the update of the international guidelines by Evenson *et al.* [10] in 2013.

In order to understand the scientific evidence in this field, and the outcomes in maternal health, it has generated wide interest in exploring the studies carried out with more relevant group exercise programs in randomized controlled trials (RCT) and in controlled trials (CT). To date, previous reviews of physical activity interventions during pregnancy have not investigated how the use of specific group exercise programs may contribute to maternal and fetal health outcomes. Therefore, the present systematic review was undertaken to evaluate the content of physical activity interventions with a specific emphasis on group exercise and its effects on maternal and fetal health outcomes.

1.2. Aims

The aims of this systematic review were to evaluate the available evidence on the effectiveness of group exercise programs in improving women's health outcomes during pregnancy, as well as newborn's health outcomes and to assess the content of the programs.

2. METHODS

2.1. Eligibility Criteria

The authors followed the methodological approach described by Bento [16]. The review was limited to studies meeting the following criteria: a) adult pregnant women with no known medical or obstetric conditions and with pre-pregnancy Body Mass Index (BMI) in the range of normal; b) interventions with the duration of a minimum of 12 weeks, based on group exercise programs designed to maintain or increase physical activity during pregnancy and targeting maternal and fetal health outcomes; c) comparison with no intervention groups of pregnant women; d) outcome variables related to pregnant women's health, physical activity and quality of life and to newborns' health; e) studies reporting randomized controlled trials and control trials were selected, since they have a higher level of evidence, in order to seek data with more significant health outcomes; f) articles published in the English, Portuguese and Spanish languages; g) articles published in the last 5 years (since 2009), in order to find the most recent data, once instruments for collection of variables are technologically more accurate and less intrusive for this population and because Lewis *et al*. [4] review was published in 2008.

2.2. Exclusion Criteria

The exclusion criteria of studies were the following: pregnant women with diagnosed type 1 or type 2 diabetes at recruitment or other pregnancy-related medical conditions; interventions specifically designed for underweight, overweight or obese pregnant women or other pregnancy-related medical conditions; inclusion of teenagers; unpublished data, theses, books and congress abstracts.

2.3. Search Strategy

Studies were identified by searching three databases: PubMed, Scopus and Scielo, from May to July 2014. The reference lists of the studies were also scanned. The following search terms were combined to be identified in the title or abstract of the article or the *Medical Subject Headings* terms: ''pregnancy / gestation / pregnant" AND "physical activity / exercise / group exercise". PubMed allowed the search of CT and RCT studies.

2.4. Study Selection

The study selection was conducted in three phases: the articles were initially screened by their titles and abstracts against the inclusion criteria; the second phase was the full

screening of the abstracts; and the third phase was the full screening of the entire article. Two members of the research team independently reviewed the papers which were ambiguous regarding inclusion criteria. In the case of duplicate studies the most relevant or most recent was included. Where disagreements occurred, all team members participated in the discussion in order to resolve it.

2.5. Data Extraction

The following data was extracted from each selected article: country and location where the study was performed; year of publication; study design; purpose; sample size; age of participants; week of gestation; type, frequency and duration of the intervention; exercise intensity; exercise and health specialists leading the program; maternal health outcomes related to intervention effectiveness, such as, health perception, quality of life, weight gain, cardiorespiratory fitness, strength and flexibility, pelvic girdle, lumbopelvic and low back pain, urinary incontinence, prevalence of gestational diabetes, glucose tolerance, hypertension, anemia, gestational age at delivery, type and duration of delivery; and newborn health outcomes to intervention effectiveness, such as, birth weight, Apgar score; as well as secondary variables such as, parity, socioeconomic status, occupational activities, pre-pregnancy weight and BMI, smoking habits and post-partum recovery.

2.6. Quality Assessment of the Studies

The Physiotherapy Evidence Database (PEDro) evaluation scale by Maher *et al*. [17], was used to assess quality and risk of bias of each study, in order to reduce bias and check internal and statistical validity of each study. Two of the researchers independently assessed risk of bias. Results were compared and a consensus reached for each study. A third member of the team was available if consensus was not reached.

3. RESULTS

3.1. Study Selection

Overall, 145 articles were identified through database search, citation and hand searching. Thirty-five articles were removed, because they were duplicates and, as well as because not meeting the inclusion criteria. In the screening process, 110 articles were identified through the searched databases and through other sources; however 74 of them were excluded after looking for duplicates and eligibility. Nineteen of the 36 articles were excluded after abstract screening. After a careful reading of the full articles, a total of 17 studies were selected for analysis (Fig. **1**).

3.2. Characteristics of the Studies

Table **1** provides the quality assessment of the studies using the PEDro scale, as well as the total score of each study.

Table **2** provides the characteristics of the studies, which were described according to sample size, age of participants, socioeconomic status, location, design, duration, aims of the study, description of the intervention, primary and secondary outcome variables and results.

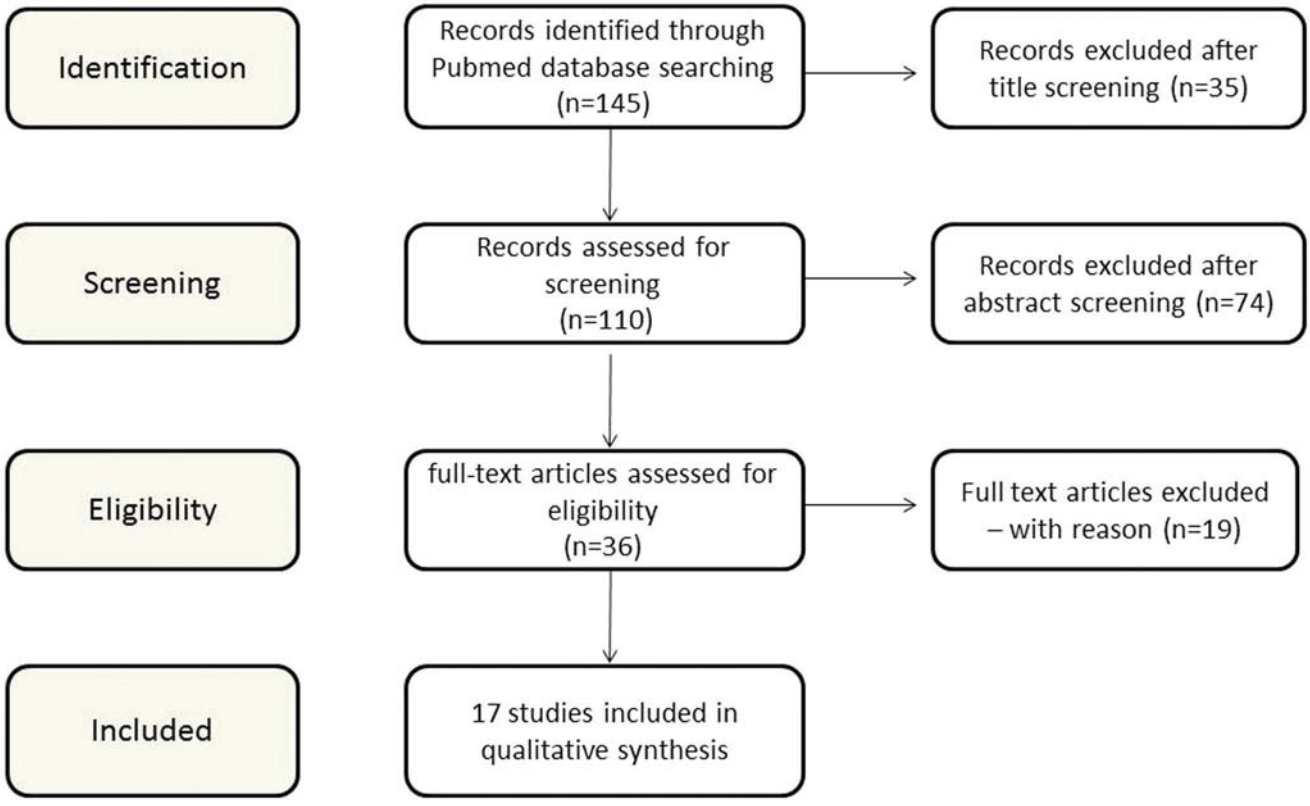

Fig. (1). Flow diagram of literature search for group exercise interventions in pregnancy.

Table 1. Quality assessment and PEDro score.

Authors	PEDro Scale											Total Score
	1	2	3	4	5	6	7	8	9	10	11	
Barakat *et al.* (2009) [18]	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	9
Barakat *et al.* (2009) [19]	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	9
Haakstad & Bø (2011) [20]	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	9
Barakat *et al.* (2011) [13]	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes	7
Bo & Haakstad (2011) [21]	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	9
Barakat *et al.* (2012) [22]	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	8
Eggen *et al.* (2012) [23]	Yes	Yes	Yes	Yes	No	No	Yes	No	Yes	Yes	Yes	8
de Oliveria Melo *et al*. (2012) [24]	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	9
Barakat *et al.* (2012) [25]	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	8
Price *et al.* (2012) [26]	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes	7
Stafne *et al.* (2012) [27]	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	8
Stafne *et al.* (2012) [28]	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	8
Halvorsen *et al.* (2013) [29]	Yes	Yes	Yes	No	No	No	No	No	Yes	Yes	Yes	6
Barakat *et al.* (2013) [30]	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes	7
Barakat *et al.* (2014) [31]	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	8
Pelaez *et al.* (2014) [32]	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	8
Salvesen *et al.* (2014) [33]	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	9

Notes: 1- eligibility criteria specified; 2 - random allocation to groups; 3 - concealed allocation; 4 - groups similar at baseline regarding the most important prognostic indicators; 5 - subjects blinding; 6 - therapists who administered the therapy blinding; 7 - assessors who measured at least one key outcome blinding; 8 - measures of at least one key outcome obtained from more than 85% of the subjects initially allocated to groups; 9 – intention-to-treat analysis; 10 – between-group statistical comparisons reported for at least one key outcome; 11 - point measures and measures of variability for at least one key (Maher, Sherrington, Herbert, Moseley, & Elkins, 2003) [17].

This review contains 17 studies including a total 2569 pregnant women, assuming that the samples of studies [20] and [21], [25] and [31], and [27, 28] and [33] are the same, according to the characteristics of the participants. The sample size across studies ranged from 80 to 855 pregnant women. The overall age group across the studies ranged from 18 to 40 years. All studies included participants from all socioeconomic status. All studies present a RCT design.

Regarding the period of intervention, most studies investigated the influence of a physical exercise program on the outcome variables, during the second and third trimesters of pregnancy [18-20, 23, 24, 26-29, 32, 33], but also from second trimester to 8 weeks postpartum [21] and during the entire pregnancy [13, 22, 25, 30, 31], as follows. All interventions lasted at least 12 weeks.

The studies were conducted in the following countries: Brazil [24], USA [26], Spain [13, 18, 19, 22, 25, 30, 31] and Norway [20, 21, 23, 27-29, 33].

3.3. Characteristics of the Interventions

The aims of all studies were to evaluate the effectiveness of a group exercise program on determined maternal and fetal health outcomes. The interventions consisted of an average of 70–75 [32] to 80-85 [13, 18, 19, 22, 25, 31] group sessions of 8–12/15 women [27, 32]. Participant involvement in the group exercise intervention ranged from one session per week to three sessions per week. The sessions were held in group, at least one [27, 28, 33], two [20, 21, 29], three [13, 18-20, 22-25, 30-32] or four [26] times per week. The sessions had 35-45 min [13, 18-20] or 45/55–60 min [25-27, 30-32] of duration.

In most of the studies the sessions were based on the 2002 ACOG [8] guidelines for exercise during pregnancy, at moderate intensity (12–14 on Borg Scale of perceived exertion) [13, 20-23, 25-33].

Each session consisted of a warm-up period (including walking and static stretching) [22, 24, 25, 30, 31], followed by 30-35 min of low impact aerobics [20, 22, 23, 25, 27, 30, 31, 33, 34] or water exercise [22] or step aerobics [26] or walking [24, 26] or circuit training [26]; 10-25 min of general strength training [20, 22, 23, 25, 27, 30-33], including pelvic floor muscle training [21-23, 25, 30, 32, 33]; 7 min of cool down (stretching and relaxation) [20, 22, 24, 25, 27, 30-33] or finishing with balance and stabilization exercises [23].

Other interventions consisted on a supervised training program focused on very light resistance and toning exercises [18, 19]. One intervention was characterized as "fitness classes" including pelvic floor muscle training

Table 2. Characteristics of the studies.

Authors and Year of Publication	Participants and Location	Study Design and Objectives	Measures	Results	PEDro Score
Barakat *et al.* (2009) [18]	Size: 160 PW without contraindications to exercise Age: 25-35 years of age Socioeconomic status: all included Location: Primary care medical centre (*Centro de Salud Maria Montesori, Leganés*), Madrid, Spain.	Type: Randomized, controlled single-blind design. Duration: From weeks 12-13 to weeks 38-39 of pregnancy Aim: To determine the possible cause-effect relationship between regular exercise performed during the 2nd and 3rd trimesters of pregnancy by previously sedentary healthy gravidae and type of delivery; dilatation, expulsion and childbirth time. Description: Training program focused on very light resistance and toning exercises, including ± 80 sessions (3 times/week, 35 min/session). Supervised by a qualified fitness specialist.	Primary: maternal and newborn characteristics, delivery type (normal, instrumental, or cesarean), and dilatation, expulsion and childbirth time Secondary: maternal age and BMI at the start of the study; prior parity and eventual preterm deliveries (before 37 completed weeks of gestation); smoking habits; occupational activities and other daily activities (number of hours standing), using the Minnesota Leisure-Time PA questionnaire.	No significant differences ($p>0.001$) between groups for type of delivery and labor times. Dilatation, expulsion and childbirth mean time did not differ between groups.	9
Barakat *et al.* (2009) [19]	Size: 160 PW without contraindications to exercise Age: 25-35 years of age Socioeconomic status: all included Location: Primary care medical centre (Centro de Salud Maria Montesori, Leganés), Madrid, Spain.	Type: Randomized, controlled single-blind design. Duration: From weeks 12-13 to weeks 38-39 of pregnancy Aim: To determine the possible cause-effect relationship between regular exercise performed during the 2nd and 3rd trimesters of pregnancy by previously sedentary, healthy gravidae and increased risk of maternal anemia. Description: Training program focused on very light resistance and toning exercises, including ± 80 sessions (3 times/week, 35 min/session). Supervised by a qualified fitness specialist.	Primary: incidence of maternal anemia and changes in hematological variables over pregnancy. Secondary: maternal age and BMI at the start of the study; prior parity and eventual preterm deliveries (before 37 completed weeks of gestation); smoking habits; occupational activities and other daily activities (number of hours standing), using the Minnesota Leisure-Time PA questionnaire.	No significant differences ($p>0.05$) for increased risk of maternal anemia nor hematological variables.	9
Haakstad & Bø (2011) [20]	Size: 105 PW nulliparous without past in structured exercise programs Age: mean 30.7 ± 4 years of age Socioeconomic status: high education level Location: Oslo, Norway	Type: RCT – 2 arm (assessor blinded), in accordance with CONSORT statement Duration: 12 weeks minimum Aim: To examine the effect of aerobic dance exercise (twice/week) and 30 min of PA in the remaining week days on birth weight including proportions of the newborns in PW nulliparous previously inactive. Description: 2 or 3 days weekly of an exercise program that includes: warm up aerobic dance (35 min), cool down, strength training (15 min), stretching, relaxation and body awareness. ACOG guidelines. Moderate intensity. Supervised by certified aerobic instructors.	Primary: birth weight, gestational age at delivery and Apgar score. Secondary: gestational weeks, marital status, education, sedentary occupations, smoking habits, height, pre-pregnancy weight, weight, pre-pregnant BMI.	Higher Apgar score (1 min) in EG and no differences in length of gestation.	9
Barakat *et al.* (2011) [13]	Size: 80 healthy, singleton, sedentary PW Age: 23-38 years of age Socioeconomic status: low to medium Location: Obstetric Hospital Department (Hospital Fuenlabrada) Madrid, Spain.	Type: Randomized, controlled training trial. Duration: From the start of the pregnancy (weeks 6-9) to the end of the 3rd trimester (weeks 38-39). Aim: To investigate the influence of a program of moderate physical exercise during the entire pregnancy on maternal perception of health status and other pregnancy outcomes. Description: The physical conditioning program included a total of 35-45 min weekly sessions, 3 days/week. An average of 85 training sessions was planned originally for each participant in the event of no preterm delivery. ACOG guidelines. Moderate intensity. Supervised by certified aerobic instructors.	Primary: Maternal perception of state of health and frequency of pregnant women to lose urine. Secondary: Maternal weight gain, gestational age, type of delivery, delivery lacerations, blood pressure, 1-hour glucose tolerance, birth weight, and Apgar score.	Significant differences ($p>0.03$) for maternal perception of health status and for maternal weight gain during pregnancy.	7

Table 2. contd….

Authors and Year of Publication	Participants and Location	Study Design and Objectives	Measures	Results	PEDro Score
Bo & Haakstad (2011) [21]	Size: 105 sedentary primiparous PW. Age: mean ± SD EG – 31.2 ± 3.7 years CG – 30.3 ± 4.4 years Socioeconomic status: all included Location: University, Oslo	Type: Single-blind RCT. Duration: From 12 to 24 weeks of pregnancy until 8 weeks afterbirth Aim: To evaluate the effectiveness of PFMT instructed in a general fitness class for PW Description: 12 weeks of training comprising twice-weekly 1-hour fitness classes including 3 sets of 8 to 12 maximal pelvic floor muscle contractions. The control group received usual care. ACOG guidelines. Moderate intensity. Supervised by certified aerobic instructors.	Primary: urinary incontinence, flatus and anal incontinence. Secondary: Age, gestational week, married or living together, level education, daily smokers, BMI.	No significant differences were found in the number of women reporting urinary, flatus or anal incontinence between the exercise group and the control group during pregnancy or at 6 weeks postpartum.	9
Barakat *et al.* (2012) [22]	Size: 83 healthy PW Age: mean ± SD 32±4 years either to an exercise group (EG, n=40) or a control (CG, n=43) group. Socioeconomic status: all included Location: Obstetric Hospital Department (Hospital Fuenlabrada) Madrid, Spain.	Type: RCT. Duration: from the start of the pregnancy (weeks 6–9) to the end of the 3rd trimester (weeks 38–39). Aim: To study the influence of an exercise program performed by healthy pregnant women on maternal glucose tolerance. Study design: A physical activity (two land aerobic sessions and one aquatic activities session) program during the entire pregnancy. 3 sessions/week. 35–45 min/session. Conducted by a qualified instructor. ACOG guidelines. Moderate intensity. PW were randomly assigned to either an exercise group (EG, n=40) or a control (CG, n=43) group.	Primary: 50 g maternal glucose screen, maternal weight gain and several pregnancy outcomes Secondary: maternal age, BMI, smoking habits, alcohol intake, occupational activity, time standing per day, time of domestic task, educational level, parity, gestational age, type of delivery, blood pressure, birth weight and Apgar score.	Significant differences were found between study groups on the 50 g maternal glucose screen. Values corresponding to the EG (103.8±20.4 mg/dl) were better than those of the CG (126.9±29.5 mg/dl), p=0.000. In addition, no differences in maternal weight gain and no cases of gestational diabetes in EG versus 3 in CG (7%) (p>0.05) were found. In conclusion a moderate PA program performed during pregnancy improves levels of maternal glucose tolerance.	8
Eggen *et al.* (2012) [23]	Size: 257 healthy PW before gestation week 20 Age: between 18 and 40 years of age Socioeconomic status: all included Location: primary care maternity units in 2 suburban municipalities in the southeastern part of Norway.	Type: an observer-blinded RCT. Duration: The groups trained for 16 to 20 weeks (between gestation weeks 16 and 36) Aim: To investigate whether a group-based exercise program can reduce the prevalence and severity of LBP and PGP in PW. Description: Treatment program consisted of 3 main components: group-based exercises, information and home exercises. Each session started with 20-30 min of aerobic activity, followed by knee bends, toe raises and pelvic floor-muscle contractions in couples, finishing with balance and stabilization exercises. Sessions led by trained physical therapists.	Primary: self-reported LBP and self-reported PGP with follow up at gestation weeks 24, 28, 32 and 36. Secondary: pain intensity in the morning and evening, disability, and 8-item SF Health Survey (SF-8) PCS and MCS scores.	No statistically significant differences. No effect of the program on the prevalence of PGP or LBP.	8

Table 2. contd….

Authors and Year of Publication	Participants and Location	Study Design and Objectives	Measures	Results	PEDro Score
de Oliveria Melo *et al*. (2012) [24]	Size: 187 previously sedentary and healthy PW (9) Age: mean between 24 ± 5.4 and 26 ± 5.3 years of age Socioeconomic status: all included Location: Public health care units, Campina Grande, Brazil	Type: RCT. Duration: From week 13 of pregnancy until birth Aim: To estimate the effect of an exercise program on uteroplacental and fetal blood flow during pregnancy, on fetal growth, frequency of preeclampsia, blood pressure levels during pregnancy, and weight and length of the newborn at birth. Description: Group A with exercise initiated at 13 weeks of gestation; group B at 20 weeks and group C without intervention. All PW continued to receive prenatal care. They were tested on a treadmill at weeks 13, 20 and 28. The supervised intervention was performed 3 times a week. The duration of walking started with 15 min, gradually increasing in accordance with woman's previous physical fitness levels until reach moderate intensity, always preceded by warming up and stretching exercises. Program developed by physical educators.	Primary: fetal growth and uteroplacental blood flow Secondary: Preeclampsia, fetal macrosomia 38 week, VO_{2max}, birth weight.	Physical fitness improved, but no association was found between the practice of physical activity and the variables investigated.	9
Barakat *et al.* (2012) [25]	Size: 320 Caucasian and healthy PW with singleton pregnancies Age: mean ± SD 31± 4 years Socioeconomic status: 290 belonged to a low-to-medium socioeconomic class Location: Participants were recruited from a hospital database, Madrid, Spain.	Type: Randomized controlled clinical trial. Duration: From weeks 6-9 to weeks 38-39 of pregnancy. Aim: To understand the influence of an exercise program during pregnancy (all 3 trimesters) on the type of delivery that ultimately occurred. Description: The physical conditioning program included a total of three 40–45 min sessions per week. An average of 85 training sessions planned for each participant. Each session included a 25 min core portion that was preceded and followed by a gradual warm-up and cool-down period, both of 7–8 min in duration and consisting of walking and light, static stretching of most muscle groups. There were used exercises covering the major muscle group in the arms and abdomen to promote good posture, prevent lower back pain and strengthen the muscles of labor and the pelvic floor. There were also included an aerobic dance section in every session. Conducted by a qualified instructor. ACOG guidelines. Moderate intensity.	Primary: type of delivery (normal, instrumental, or cesarean) and pregnancy outcomes from hospital perinatal records including gestational age (days), preterm deliveries (before the completion of 37 weeks gestation), maternal weight gain (kg), blood pressure, 1-h oral glucose tolerance test, cases of GD, birth weight/length, pH of the umbilical cord blood and Apgar score. Secondary: maternal age, parity, smoking habits during pregnancy, occupational activity, time standing per day, time spent on domestic activities, educational level, BMI and adherence.	The percentage of cesarean and instrumental deliveries in the exercise group was lower than in the control group. The overall health status of the newborn as well as other pregnancy outcomes was unaffected.	8

Table 2. contd….

Authors and Year of Publication	Participants and Location	Study Design and Objectives	Measures	Results	PEDro Score
Price *et al.* (2012) [26]	Size: 91 inactive PW Age: mean ± SD EG: 30.5 ± 5 years; CG: 27.6 ± 7.3 years Socioeconomic status: all included Location: Austin, Texas, USA.	Type: Prospective RCT. Duration: From 12 to 14 weeks of gestation until 36 weeks or delivery if they wished. Aim: To assess the benefits and possible risks of aerobic exercise during pregnancy, using a fitness regimen based on the ACOG guidelines for exercise during pregnancy. Description: The intervention involved a program of supervised aerobic training of 45–60 min duration, performed 4 times/week, at moderate intensity (12–14 on Borg Scale of perceived exertion). There were 4 exercises modes for each week day: on the 1st day - step aerobics; on 2nd day - walked as a group; on the 3rd day - circuit training; on the 4th day - brisk of 30-60 min walk individually. All study participants underwent five fitness assessments: at weeks; 12–14, 18–20, 24–26, 30–32 and at 6–8 postpartum.	Primary: Cardiorespiratory Fitness, length of pregnancy and newborn weight Secondary: Strength, flexibility, discomfort and pregnancy complications like; incidence of gestational diabetes, gestational hypertension, delivery data. Length of first and second stage of labor, route of delivery, need for vacuum or forceps, newborn Apgar scores, placenta weight after draining the placenta and total maternal weight gain.	Active PW improved aerobic fitness and muscular strength, delivered comparable size infants with significantly fewer cesarean deliveries, and recovered faster postpartum, at least related to the lower incidence of cesarean section. EG developed no gestational hypertension and reported no injuries related to the exercise regimen. There were no differences between groups in the incidence of gestational diabetes, musculoskeletal pains during pregnancy, flexibility on sit-and-reach test, mean length of pregnancy, neonatal Apgar scores, placenta weights, overall length of labor, weight gain during pregnancy, or weight retention postpartum.	7
Stafne *et al.* (2012) [27]	Size: 855 PW with a singleton live fetus Age: mean ± SD EG: 30.5 ± 4.4 years; CG: 30.4 ± 4.3 years Socioeconomic status: all included Location: St. Olavs Hospital, Trondheim University Hospital and Stavanger University Hospital, Norway.	Type: two-armed, two-center RCT. Duration: Over a period of 12 weeks between the 20th and the 36th week of pregnancy. Aim: To assess whether PW following a general exercise course, including PFMT, were less likely to report urinary and anal incontinence in late pregnancy than a group of women receiving standard care. Description: The intervention was one weekly group session led by physiotherapists, and home exercises encouraged at least twice a week. Moderate intensity. CG received regular antenatal care.	Primary: Urinary and anal incontinence, as measured by self-report. Secondary: Weight and BMI.	After the intervention period, significantly less women in the intervention group reported UI and stress UI. The findings were consistent when adjusting for baseline values. A lower proportion of women in the intervention group than in the CG reported fecal incontinence; however, the difference was not statistically significant.	8
Stafne *et al.* (2012) [28]	Size: 855 PW with a singleton live fetus Age: mean ± SD EG: 30.5 ± 4.4 years; CG: 30.4 ± 4.3 years Socioeconomic status: all included Location: St Olavs Hospital, Trondheim University Hospital and Stavanger University Hospital, Norway	Type: A two-armed, two-center, RCT. Duration: Over a period of 12 weeks between the 20th and the 36th week of pregnancy. Aim: To study lumbopelvic pain in PW on a regular exercise program in comparison to PW receiving standard antenatal care. Description: The intervention included aerobic and strengthening exercises. Moderate intensity. Physiotherapists led one weekly group session, and home exercises were encouraged twice/week. The exercise program included aerobic activity, strength training and balance exercises. Training sessions were of 60 min in groups of 8–15 women.	Primary: Main outcomes in the present study were the prevalence of LPP and sick leave due to LPP. Secondary: Disability, pain intensity and fear-avoidance beliefs about physical activity.	There were no significant differences between groups of PW reporting LPP at 36 weeks. The proportion of women on sick leave due to LPP was lower in the intervention group. However, the proportion of women on sick leave due to LPP and the odds ratio was lower in the intervention group.	8

Table 2. contd….

Authors and Year of Publication	Participants and Location	Study Design and Objectives	Measures	Results	PEDro Score
Halvorsen *et al.* (2013) [29]	Size: 62 sedentary primiparous PW Age: mean ± SD 30.6 ± 3.7 years Socioeconomic status: all included Location: University, Oslo, Norway	Type: RCT. Duration: between September 2007 and March 2008. Aim: To evaluate the effectiveness of aerobic dance on cardiorespiratory fitness in PW. Description: The exercise program consisted on 2 choreographed aerobic dance classes per week and 30 min of daily self-imposed physical activity for 12 weeks. Led by certified aerobics instructors. The PW in the exercise group were advised to undertake at least 30 min of moderate physical activity on the remaining week days.	Primary: Cardiorespiratory fitness (oxygen uptake, work load, heart rate), rating of perceived exertion.	There were no differences in change between the groups at any level. Both groups had a small significant decrease in VO_2 between baseline and post-intervention.	6
Barakat *et al.* (2013) [30]	Size: 200 PW with uncomplicated and singleton gestation Age: mean ± SD 31.5 ± 3.9 years Socioeconomic status: all included Location: Hospital Fuenlabrada, Madrid, Spain.	Type: RCT. Duration: From weeks 6-13 to weeks 39-40 of pregnancy. Aim: To examine the influence of a program of moderate physical exercise throughout pregnancy on maternal and fetal parameters. Description: A supervised physical conditioning program that included 3 sessions/week. 55-60 min/session. Every session started with 5 min of walking and static stretching of most muscle groups to warm up. The warm-up was followed by toning and joint mobilization exercises, aerobic dance, and specific exercises that targeted the major muscle groups in the legs, buttocks, and abdomen to stabilize the lower back; balancing exercises were also included. Every session concluded with pelvic floor muscle training and a cool-down period. Supervised by aerobic instructors.	Primary: Maternal: gestational age, weight gain, type of delivery, blood pressure during pregnancy, gestational diabetes. Fetal: birth weight and size, head circumference, Apgar score, pH of umbilical cord. Secondary: maternal age, BMI, smoking habits, parity, and preterm delivery.	There were significantly more PW in the CG who gained excessive weight during their pregnancies than in the EG. The effect size was small. Other pregnancy outcome showed no differences between groups.	7
Barakat *et al.* (2014) [31]	Size: 320 healthy PW with singleton gestation. Age: mean ± SD, 31 ± 4 years Socioeconomic status: all included Location: obstetrics department of the Hospital Fuenlabrada, Madrid, Spain.	Type: RCT. Duration: From weeks 8-10 to weeks 38-39 of pregnancy Aim: to examine the influence of an aerobic exercise program throughout pregnancy on gestational age at the moment of delivery. Description: General fitness class, 3 times/week, 55–60 min/session. The exercise program included 85 sessions. The exercises covered the major muscle groups of the body, abdomen to promote good posture, prevent low back pain and strengthen the muscles of labor and pelvic floor training. It was included in the program 1 set of low impact of aerobic dance session per week. Supervised by aerobic instructors.	Primary: gestational age at moment of delivery, maternal age, BMI, smoking habits during pregnancy, occupational activity, time standing per day, time of domestic task, educational level and parity Secondary: gestational weight gain, type of delivery, blood pressure, 1h oral glucose tolerance test, birth weight/length, pH of the umbilical cord and Apgar Scores.	There were no significantly differences for all between-group.	8

Table 2. contd….

Authors and Year of Publication	Participants and Location	Study Design and Objectives	Measures	Results	PEDro Score
Pelaez *et al.* (2014) [32]	Size: 169 PW (9) without UI (11) Age: mean ± SD; EG: 29.9 ± 3.3 years; CG: 29.1 ± 4.5 Socioeconomic status: all included Location: Fuenlabrada University Hospital, Madrid, Spain.	Type: Unicenter two armed RCT. Duration: At least 22 weeks (from 14 to 36 weeks). Aim: To investigate the effect of PFMT taught in a general exercise class during pregnancy on the prevention of UI in nulliparous continent PW. Description: The program consisted of 70–75 group sessions (8–12 women). 3 sessions/week. 55-60 min/session. Each session consisted of 8 min of warm-up; 30 min of low impact aerobics (performing different choreographies) including 10 min of general strength training (e.g., core muscles, pectoralis, gluteus, quadriceps, calves, biceps); 10 min of PFMT and 7 min of cool down, which included stretching, relaxation or massage. Supervised by aerobic instructors.	Primary: reported frequency, amount and impact on daily life of UI. Secondary: mean age, pre-pregnancy BMI, education, and pre-pregnancy physical exercise habits at baseline.	Statistically significant difference in favor of the EG in reported frequency of UI, amount of leakage and in ICIQ-UI SF, score between groups after the intervention period and the estimated effect size was 0.8.	8
Salvesen *et al.*(2014) [33]	Size: 855 PW with a singleton live fetus Age: mean ± SD; EG 30.5 ± 4.4 years; CG: 30.4 ± 4.3 years Socioeconomic status: all included Location: St. Olavs Hospital, Trondheim University Hospital and Stavanger University Hospital, Norway	Type: two-armed, two-center RCT. Duration: Over a period of 12 weeks between the 20th and the 36th week of pregnancy. Aim: To study the effects of regular physical exercise in pregnancy on duration of the active phase of labor and the proportions of women with prolonged active second stage. Description: Consisted of 30–35 min low impact aerobics, 20–25 min strength exercises, including pelvic floor muscle training, and 5–10 min light stretching and body awareness. Women trained in groups with a physiotherapist. The EG was encouraged to follow a written 45 min home exercise program at least twice a week (30 min aerobic activity and 15 min strength and balance exercises).	Primary: Mean duration of labor and mean duration of active second stage of labor. Secondary: Maternal age, BMI at 18 weeks, prolonged second stage, epidural analgesia, oxytocin augmentation, operative vaginal delivery, cesarean section, episiotomy, perineal laceration grade and postpartum hemorrhage.	There were no differences in the duration of active phase (total length) of labor. Between groups there were no differences in; mean gestational age at birth, mean birth weight, in the numbers of preterm births or small for gestational age babies. Nulliparous but not parous women in the EG had a significantly longer active second stage of labor as compared with the CG.	9

Legend:

- ACOG - American College of Obstetricians and Gynecologists;
- BMI – body mass index;
- BPP – birth preparation program;
- CG – control group;
- EG – experimental group;
- FFA – free fatty acids;
- GD – Gestational Diabetes;
- ICIQ-UI SF – International consultation on incontinence questionnaire-urinary incontinence short form;
- IGF – insulin-like growth factor;
- IIQ-7 - Urogenital Distress Inventory;
- LBP – low back pain;
- LPP – lumbopelvic pain;
- MCS - Mental Component Summary;
- NET – neuro emotional technique;
- PA – physical activity;
- PCS - Physical Component Summary;
- PFM – pelvic floor muscle;
- PFME - pelvic floor muscle exercise;
- PFMT – pelvic floor muscle training;
- PGH – placental growth hormone;
- PGP – pelvic girdle pain;
- PRLBP – pregnancy-related low back pain;
- PW – pregnant women;
- RCT – randomized controlled trial;
- SF - short-form;
- SMT – spinal manipulative therapy;
- UDI-6 - Urogenital Distress Inventory;
- UI - urinary incontinence.

(PFMT) [21]. In the intervention groups exercising in group once per week [23, 27, 28, 33] the participants were encouraged to follow a written 45-min home exercise program at least twice a week (30 min aerobic activity and 15 min strength and balance exercises). In the intervention groups exercising in group twice per week [29] the participants were encouraged to 30 min of daily self-imposed physical activity for 12 weeks. In one intervention of three times per week of group exercise training, they were encouraged to perform a fourth session of individually walking [26].

The exercise programs were supervised and led by certified aerobics/fitness instructors [13, 18-22, 24-25, 29-32] or by physiotherapists [23, 27, 28, 33]. The control groups included pregnant women receiving standard antenatal care, although the authors of the different studies did not describe the characteristics of the "standard care".

3.4. Maternal and Fetal Physical Activity and Health Outcomes

The following effects of the exercise intervention on maternal outcomes were analyzed (primary variables): maternal perception of state of health [13], adherence to the exercise program [25], 8-item short form Health Survey (SF-8), Physical Component Summary (PCS) and Mental Component Summary (MCS) scores [23], cardiorespiratory fitness (oxygen uptake) [26, 29], maximal oxygen uptake [24], strength [26], flexibility [26], work load [29], heart rate [29], rating of perceived exertion [29], gestational weight gain [13, 20, 22, 25, 26, 28, 30, 31], BMI [20-22, 25, 28, 30, 31], gestational diabetes [22, 25, 26, 30], oral glucose tolerance [13, 22, 25, 31], hypertension/blood pressure during pregnancy [13, 22, 25, 26, 30, 31], preeclampsia [24], incidence of maternal anemia [19], changes in hematological variables over pregnancy [19], discomfort and pregnancy complications [26], disability [23, 27], prevalence of lumbopelvic pain (LPP) [23, 27] or pelvic girdle pain (PGP) [23], pain intensity in the morning and evening [23], sick leave due to LPP [27], pain intensity and fear-avoidance beliefs about physical activity [27], reported frequency of urinary incontinence during pregnancy [13, 21, 28, 32], flatus [21], anal incontinence [21, 28], preterm delivery (before the completion of 37 weeks gestation) [25, 30], gestational age at moment of delivery [13, 20-22, 25, 26, 30, 31], type of delivery: normal, instrumental (need for vacuum or forceps), or cesarean [13, 18, 22, 25, 26, 30, 31], delivery lacerations [13], mean duration of labor and mean duration of active first and second stages of labor [18, 26, 33], uteroplacental blood flow [24], placenta weight after draining the placenta [26], and route of delivery [26].

The following effects of the exercise intervention on fetal outcomes were analyzed (primary variables): birth weight and length [13, 18, 20, 22, 24-26, 30, 31], fetal growth and macrosomia [24], head circumference [30], pH of the umbilical cord [25, 30, 31] and Apgar Scores [13, 20, 22, 25, 26, 30, 31].

Also, the following secondary variables were analyzed: maternal age, education, pre-pregnancy weight, height and BMI or at the start of the study [18-20, 22], eventual preterm deliveries (before 37 completed weeks of gestation) [18, 19], smoking habits during pregnancy [18-22, 25, 30, 31], alcohol intake [22], sedentary occupations [20, 22], occupational activity [18, 19, 22, 25, 31], time standing per day [18, 19, 31], time of domestic tasks [25, 31], pre pregnancy exercise habits [22] and parity [19, 20-22, 25, 30].

3.5. Effectiveness of the Interventions

As main and significant effects of the interventions, the authors reported the following: improved maternal perception of health status in the exercise group [13]; and in maternal weight gain during pregnancy [13]; the intervention and the control groups had a small significant decrease in oxygen uptake (VO_2) between baseline and post-intervention [29]; active pregnant women improved aerobic fitness and muscular strength [26]; physical fitness improved, but no association was found between the practice of physical activity and the variables investigated [24]; the exercise group delivered comparable size infants with significantly fewer cesarean deliveries [26], and recovered faster postpartum, at least related to the lower incidence of cesarean section [26]; the intervention group developed no gestational hypertension and reported no injuries related to the exercise regimen [26]; the overall health status of the newborn as well as other pregnancy outcomes was unaffected [25]; the intervention group reported a lower frequency of urinary incontinence (UI) and amount of leakage after the intervention [28, 32]; there were no significant differences between groups of women reporting LPP in the third trimester but the proportion of women on sick leave due to LPP was lower in the intervention group [27]; a moderate physical activity program performed during pregnancy improved the levels of maternal glucose tolerance [22]; nulliparous but not parous women in the intervention group had a significantly longer active second stage of labor as compared with the control group [33]; there were more pregnant women in the control group who gained excessive weight during their pregnancies than in the exercise group [30]; the percentage of cesarean and instrumental deliveries in the exercise group was lower than in the control group [25]; higher newborn Apgar score (1 min) in the intervention group [20].

There were no differences in change between the intervention and the control groups at any level, regarding the other variables in analysis.

4. DISCUSSION

The present review was focused on RCT studies with pregnant women that evaluated the effect of group exercise programs on the health outcomes of mother and newborn. Despite the large number of the samples, we found few studies which results show little consistency in the methods used to assess the outcome variables, duration of the intervention, intensity control and statistical results.

No studies proceeded to the assessment of previous levels of physical activity among pregnant women engaged in the group exercise programs. It is not clear the effectiveness of the home based programs combined with group exercise.

On the other hand most studies present high level of quality and followed a supervised structured exercise

program including a warm-up, main aerobic part (low-impact/dance aerobics, step aerobics, water exercise, walking and circuit training), resistance training, pelvic floor training, stretching and relaxation sections. Most studies report that the program followed the ACOG [8] guidelines for exercise during pregnancy and were supervised by certified fitness instructors.

The significant effects of the group exercise programs are related with the following variables that were improved in the intervention group during pregnancy, between baseline and post-intervention and when compared to the control group of pregnant women getting usual care: maternal perception of health status [13]; maternal weight gain [13, 30]; improved glucose tolerance [22]; aerobic fitness and muscular strength [24, 26]; sick leave due to LPP [27]; lower frequency of UI [28, 32]; fewer cesarean and instrumental deliveries [25, 26]; nulliparous but not parous women had a significantly longer active second stage of labor [33]; higher newborn first minute Apgar score [20]; and faster postpartum recovery [26].

Also, the intervention group reported no gestational hypertension and no injuries related to the exercise regimen [26] and the overall health status of the newborn as well as other pregnancy outcomes was unaffected [25].

Regarding the other variables in analysis, such as gestational diabetes, there were no differences between baseline and post-intervention or between the intervention and the control groups. Maybe these findings are related to poor control in nutrition advice, more difficult control of intensity during a group exercise program, and lack of information on the previous level of physical activity of the intervention and control groups.

It is important to perform other intervention studies aiming to test the hypothesis of increased effectiveness of the group exercise programs regarding the longer duration of the intervention (longer than 12 weeks) and intensity control (heart rate and Borg scale), as well as on the evaluation of the group exercise interventions conducted by exercise specialists, on adherence, mood, quality of life and other physiologic outcomes of the pregnant women.

Other issue worth of analysis would be the combination of a group exercise program with nutritional counselling as well as to establish the guidelines and effectiveness of a home based program combined with other group outdoor activities, such as walking or cycling. Further research in this field will provide more information for conducting group exercise programs and providing valuable contribution for the recommendations for exercise and physical activity during pregnancy, in line with Takito *et al*. [34].

The main strengths of this review are that a systematic approach was adopted and the quality of the RCT studies is high. The main limitations are that even using major databases, there is a possibility that other relevant studies were not included, especially if they were published during the second semester of 2014.

5. CONCLUSION

The RCT studies included in the present review reported significant effects of the group exercise programs which are related with improved maternal perception of health status, lower maternal weight gain, improved glucose tolerance, improved aerobic fitness and muscular strength, lower frequency of urinary incontinence, improved sick leave due to lumbopelvic pain, fewer cesarean and instrumental deliveries, higher newborn Apgar score and faster postpartum recovery.

In line with Nascimento *et al*. [6] we believe that these studies add evidence to the current guidelines for exercising during pregnancy [10] regarding the mode of aerobic exercise, the components of each session, the frequency of 2-4 times/week, the session duration of 35-60 min, and the moderate intensity.

Exercise and health professionals should advise pregnant women that aerobic group exercise training during pregnancy improves a wide range of health outcomes for the women themselves and for the newborn.

CONFLICT OF INTEREST

The authors declare no commercial relationships or conflict of interests.

ACKNOWLEDGEMENTS

The present publication was supported by the research project "*Parque de Ciência e Tecnologia do Alentejo - Laboratório de Investigação em Desporto e Saúde*" (Alentejo's Science and Technology Park – Sport and Health Research Center), implemented by *Instituto Politécnico de Santarém - Escola Superior de Desporto de Rio Maior / Escola Superior de Saúde de Santarém* (Polytechnic Institute of Santarém - Sport Sciences School of Rio Maior / Health School of Santarém), funded by *QREN - Programa Operacional do Alentejo 2007-2013* (ALENT-07-0262-FEDER-001883). Project Coordinator: Rita Santos-Rocha. The funder had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

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Received: February 07, 2015 Revised: March 10, 2015 Accepted: April 03, 2015