European Journal of Obstetrics & Gynecology and Reproductive Biology 242 (2019) 170–177

Contents lists available at ScienceDirect

European Journal of Obstetrics & Gynecology and Reproductive Biology

journal homepage: www.elsevier.com/locate/ejogrb

Review article

Effects of exercise on pregnant women's quality of life: A systematic review

Na Liu[a], Wei-hui Gou[b], Jie Wang[a], Dan-dan Chen[a], Wei-jia Sun[a], Ping-ping Guo[a], Xue-hui Zhang[a], Wei Zhang[a,*]

[a] Nursing School of Jilin University, Changchun, Jilin Province, China
[b] Department of Pediatrics, The First Hospital of Jilin University, Changchun, Jilin Province, China

ARTICLE INFO

Article history:
Received 29 December 2018
Received in revised form 4 March 2019
Accepted 10 March 2019

Keywords:
Exercise
Pregnant women
Quality of life
Systematic review

ABSTRACT

Objectives: Exercise is a promising approach to improve the health of pregnant women. However, data from studies investigating exercise and the quality of life of pregnant women are inconsistent and, to date, no systematic review on this topic has been published. The aim of this review was to comprehensively assess the effects of exercise on pregnant women's quality of life, and to determine whether exercise positively affects quality of life in this population.

Study design: Literature was retrieved from electronic databases, namely PubMed, EMBASE, Web of Science and the Cochrane Library, from inception to 30 October 2018. Clinical trials published in English evaluating the effects of exercise on pregnant women's quality of life were included. The authors assessed the risk of bias in all eligible studies using the Effective Public Health Practice Project, and used a qualitative synthesis method to identify the effects of exercise on pregnant women's quality of life.

Results: Thirteen studies were included. Exercise was divided into the following four modes: aerobic exercise, resistance exercise, a combination (aerobic and resistance exercises), and yoga or physical activity. Aerobic and resistance training had a mixed effect on pregnant women's quality of life, while the combination of aerobic and resistance exercises and yoga or physical activity resulted in significant improvements.

Conclusions: This systematic review is the first to suggest that group-based combined exercise and yoga or physical activity are associated with significant benefits related to improvements in pregnant women's quality of life. Furthermore, aerobic or resistance exercise could potentially improve pregnant women's quality of life. Therefore, it is recommended that medical service providers should pay more attention to the importance of exercise, and develop tailored exercise programmes to promote improvements in pregnant women's quality of life.

Contents

* Corresponding author at: Nursing School of Jilin University, Changchun, Jilin Province 130021, China.
E-mail address: hlzhangw99@163.com (W. Zhang).

https://doi.org/10.1016/j.ejogrb.2019.03.009
0301-2115/

Introduction

Pregnant women's quality of life (QoL) is considered to be a predictor of the development of a country's public health. QoL is defined as a multidimensional concept that refers to an individual's negative or positive subjective assessment of life. QoL includes physical and mental health perceptions and their relevance, such as health-related QoL (HRQoL), which is the most common subjective factor affecting the health of pregnant women [1].

However, given the impact of pregnancy on the mother's body, unsurprisingly, pregnant women's QoL declines as pregnancy progresses [2,3]. Studies have also revealed that women's QoL is significantly lower during pregnancy than prepregnancy [4]. The main reasons for this decrease are that women experience physical, psychological and social problems during pregnancy [2,5]. Thus, the effects of pregnancy on different aspects of women's health, pregnancy-related problems and coping with pregnancy are all related to low QoL in pregnant women [6]. Notably, in several studies, pregnant women's positive QoL perception led to benefits, such as the promotion of breastfeeding attitudes and sleep quality [7,8]. Poor QoL among pregnant women suggests that they experience negative conditions, such as depression, stress and pregnancy-related complications, that can lead to poor pregnancy outcomes, such as a low birth weight, and can endanger both maternal and child health [9]. Therefore, this apparently undesirable phenomenon underscores the importance of exploring factors that lead to a decline in pregnant women's QoL, and developing targeted improvement measures.

Consistent with guidelines from the American College of Obstetricians and Gynecologists [10], the latest exercise guidelines for Americans also suggest that pregnant women should perform at least 150 min of moderate-intensity aerobic exercise every week [11]. However, because pregnant women experience physiological changes during pregnancy that might reduce their ability to exercise, the specific exercise programmes could change significantly throughout their pregnancy [3,12]. Available evidence shows that pregnant women spend more than 50% of their time being sedentary [13], and previous studies have shown that approximately 98% of pregnant women only participate in mild exercise and that fewer than 20% of pregnant women meet the recommendations for prenatal exercise [14,15]. For example, available data showed that from 2007 to 2014, only 23.4% of pregnant women in the USA met the minimum recommendation of at least 150 min of exercise per week [16]. Notably, previous studies have shown that reduced exercise during pregnancy is a key factor negatively affecting pregnant women's QoL [17]. Therefore, encouraging pregnant women to exercise might effectively improve their QoL [17,18].

Existing reviews have explored the effects of exercise on improvements in prenatal depression [19], gestational weight gain [20] and pregnancy-related symptoms [15,21]. However, the combined evidence supporting the effectiveness of exercise on pregnant women's QoL is limited, and the current results are inconsistent [12,18,22–24]. Clarification regarding the relationship between exercise and pregnant women's QoL could help improve women's satisfaction and their physical and mental health during pregnancy, which in turn could reduce the societal burden of adverse pregnancy outcomes, further providing a foundation for future research investigating the application of exercise in female reproductive health. Therefore, the aim of this review was to perform the first systematic review exploring the effects of exercise on pregnant women's QoL, and to provide a reference for future research.

Methods

Search strategy

Based on the Preferred Reporting Items for Systematic Review and Meta-Analysis guidelines [25], two reviewers (LN and WJ) independently performed a comprehensive literature search of four electronic databases: PubMed, EMBASE, Web of Science and the Cochrane Library. All databases were searched for articles published from their inception to 30 October 2018 using the following MeSH terms and keywords: ('exercise' OR 'physical activity') and ('pregnant women') and ('quality of life'). The initial screening was performed by viewing the titles and abstracts, and the full text was obtained if there was ambiguity regarding eligibility.

Eligibility criteria

Clinical trials investigating the impact of exercise lasting $\geq$4 weeks (avoiding studies that investigated the acute effects of exercise) [26] on QoL in pregnant women were included. Exercise referred to any body movement that caused increased energy consumption, including planned and structured systematic movements, based on frequency, intensity and duration to maintain or enhance health-related outcomes [27]. The exclusion criteria were as follows: (1) the control groups had similar exercise practices as the intervention groups; (2) no QoL-related outcome measures were available; and (3) articles were published in a language other than English. Studies in which exercise was one of multiple interventions, such as combined dietary interventions, were also excluded.

Data extraction

Relevant information was extracted using standardized extraction forms. All data were extracted independently by two reviewers (CDD and SWJ), and any inconsistencies were resolved through discussion with a third reviewer (ZW). Due to systematic study differences, such as heterogeneity in the study design and results, no meta-analysis was conducted to avoid an increase in heterogeneity.

Quality assessment

The risk of bias of the included studies was evaluated using the Effective Public Health Practice Project [28], which assesses

evidence of selection bias, study design, confounders, blinding, data collection methods, withdrawal and drop-outs by testing six domains. The studies were rated as 'strong', 'moderate' or 'poor', and any differences were resolved by discussion until consensus was reached.

Results

Study selection

The literature screening process is presented in Fig. 1. In total, 616 studies were identified, and 13 studies [2,3,5,12,22–24,29–34] involving 2202 participants were included. Except for two controlled clinical trials [32,34], the remaining studies were randomized controlled trials. Seven studies were conducted in Europe, while the other studies were conducted in South America ($n = 3$), North America ($n = 1$), Asia ($n = 1$) and Oceania ($n = 1$). In addition, 1016 participants included in eight studies [2,3,5,12,23,24,31,32] had high-risk features, such as overweight/obesity, a sedentary lifestyle, gestational diabetes mellitus (GDM) and low back pain (LBP), accounting for 46.14% of the total population (Table 1).

Reported outcomes

Eight studies reported significant improvements, while the other five studies revealed no significant differences between groups. Exercise was divided into the following four modalities: aerobic ($n = 3$), resistance ($n = 4$), combined (aerobic and resistance) ($n = 3$), and yoga or physical activity (PA) ($n = 3$).

Aerobic exercise

Three studies [2,23,29] involving 205 participants were analysed. One study [29] used the Colombian version of the Medical Outcome Study Short-Form Health Survey (SF-12), and two studies [2,23] used the abbreviated version of the World Health Organization Quality of Life (WHOQOL-BREF) instrument.

One trial [29] stated that the participants in the exercise group reported significantly higher scores in three of the four domains of the physical component summary of QoL, namely the physical function, bodily pain and general health domains. However, no significant differences were observed in either study [2,23]. Vallim et al. [2] assessed the effectiveness of water aerobics, and revealed no significant improvement in the QoL of sedentary pregnant women. Seneviratne et al. [23] investigated the effects of a stationary cycling programme on the QoL of overweight/obese [body mass index (BMI) $\geq 25\ kg/m^2$] pregnant women, but no significant improvement was observed in the QoL of the participants in the exercise group.

Resistance exercise

Four studies [5,12,31,33] involving 354 participants were analysed. Nascimento et al. [5] used the WHOQOL-BREF instrument, and three studies [12,31,33] used the 36-item Medical Study Short-Form Health Survey (SF-36).

Two studies [12,31] showed that resistance exercise could significantly improve pregnant women's QoL. O'Connor et al. [12] rated the efficacy of a resistance exercise programme on the QoL of pregnant women with LBP or a history of LBP during the second trimester, and the subjects in the exercise group reported a higher score in the vitality domain of the mental component summary of QoL. Moreover, Akmese and Oran [31] evaluated the effect of progressive muscle relaxation exercise on pregnant women's QoL. Similarly, after the intervention, the participants in the exercise group reported significantly higher scores in the physical and mental component summary of QoL. However, two other studies [5,33] found no improvements in pregnant women's QoL. Nascimento et al. [5] tested the impact of a physical exercise

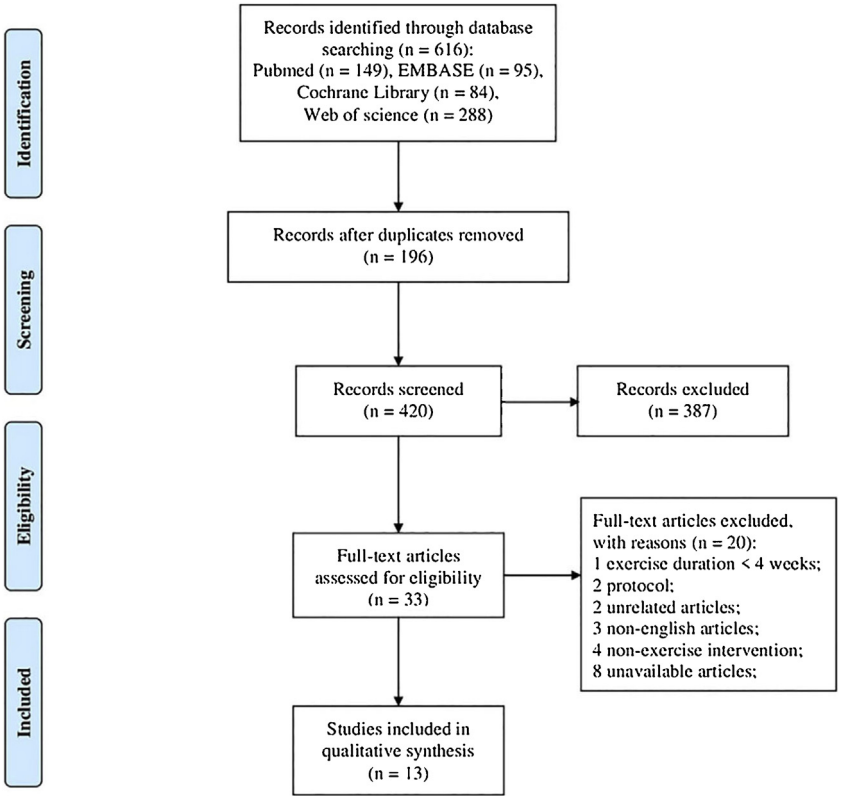

Fig. 1. Flow diagram of study screening.

Table 1
Characteristics of included studies.

Author	Country	Targeted population	Participants (E/C)	Exercise characteristics	Auxiliary intervention	Control group	Initiation time	Adherence	Assessment tools	Assessment time	Results
Montoya, 2010	Colombia	Nulliparous women	E = 33 (19 ± 3 y, 18 ± 3 w), C = 31 (20 ± 3 y, 17 ± 4 w)	T: supervised aerobic exercise; I: moderate to vigorous; D: 12 weeks; F: three 60-min exercise classes per week; f: group exercise	Exercise accompanied by music	Usual prenatal care	16–20 weeks of gestation	75%	SF-12	At baseline (16–20 weeks of pregnancy) and 28–32 weeks of pregnancy	Improvements in the physical function, bodily pain and general physical health domains
Rakhshani, 2010	India	Normal pregnant women	E = 51 (26.23 ± 2.98 y), C = 51 (25.47 ± 2.87 y)	T: integrated yoga; D: from recruitment until delivery; F: three 60-min yoga classes per week; f: NM	All participants used a prerecorded cassette at home until delivery; received a 60-min refresher class during regular antenatal check-ups; exercise was recorded in a diary	Standard antenatal exercises	18–20 weeks of gestation	NM	WHOQOL	At baseline (18–20 weeks of pregnancy) and 36 weeks of pregnancy	Improvements in the physical, psychological, social relationships, environmental and general health domains
Nascimento, 2011	Brazil	Pregnant obese and overweight women (pregestational BMI ≥ 26 kg/m^2)	E = 40 (29.7 ± 6.8 y), C = 42 (30.9 ± 5.9 y)	T: supervised exercise; I: light to moderate; F: 40-min exercise class each week; f: NM	All participants received home exercise counselling for 5 min per week and standardized nutritional counselling	Routine prenatal care advice	14–24 weeks of gestation	62.50%	WHOQOL-BREF	At baseline and the end of the 36th week of pregnancy	No significant between-group difference
Vallim, 2011	Brazil	Sedentary pregnant women	E = 31 (26 y), C = 35 (24 y)	T: water aerobics exercise; I: moderate; D: from recruitment until delivery; F: three 50-min classes per week; f: NM	None	Routine prenatal care	<20 weeks of gestation	60%	WHOQOL-BREF	At baseline and 28 and 36 weeks of pregnancy	No significant between-group difference
Kolu, 2014	Finland	Women with at least one GDM risk factor	E = 80 (29.4 ± 0.51 y), C = 258 (29.8 ± 0.29 y)	T: physical activity; I: moderate; D: from recruitment to 37th week; F: at least 150 min of leisure-time exercise per week; f: group exercise	Exercise group involved five of the 11–15 antenatal care visits; intensive one-on-one dietary and physical activity counselling; participate in five separate 2-h physical activity group sessions	Routine care and no counselling beyond the usual care (below these recommended levels)	8–12 weeks of gestation	NM	15D	At 8–13 and 36–37 weeks of pregnancy	Improvements in mobility, sleep and usual activities
Claesson, 2014	Sweden	Obese (BMI ≥ 30 kg/m^2) women without any disease or complication during pregnancy and the postpartum period	E = 74 (29.7 ± 4.43 y), C = 79 (29.6 ± 4.58 y)	I: at least moderate; D: at least 15 weeks of pregnancy; F: at least 30 min per day, three or more times per week; f: NM	None	Same recommendations concerning exercise during pregnancy, but below the recommended amount	NM	NM	SF-36	At 15 and 35 gestational weeks and at 11 weeks postpartum	Improvements in the physical function, bodily pain; social function, role emotional and general mental health domains
Akmese, 2014	Turkey	Pregnant women with LBP	E = 33, C = 33	T: progressive muscle relaxation training; D: 8 weeks; F: 20 min twice per day (morning and evening); f: group exercise	Exercise group visited the obstetrics polyclinic, and all errors in performance were identified	Laid down and did nothing for 20 min twice per day (morning and evening)	12–24 weeks of gestation	NM	SF-36	At baseline, 4 weeks and 8 weeks of exercise intervention	Improvements in the physical function, bodily pain, role-physical, general physical health; vitality, social function, role-emotional and general mental health domains

Table 1 (*Continued*)

Author	Country	Targeted population	Participants (E/C)	Exercise characteristics	Auxiliary intervention	Control group	Initiation time	Adherence	Assessment tools	Assessment time	Results
Petrov, 2014	Sweden	Women with singleton pregnancies	E = 38 (30.8 ± 3.6 y), C = 34 (30.6 ± 3.4 y)	T: supervised resistance training; I: moderate to vigorous; D: 12 weeks; F: 60-min twice per week; f: group exercise	Listening to music	Generalized exercise advice, a home-based training programme, a telephone follow-up and chance for free visit to physiotherapist	14 weeks of gestation	NM	SF-36	At baseline and 25 weeks of pregnancy	No significant between-group difference
Seneviratne, 2016	New Zealand	Women with BMI ≥ 25 kg/m^2 and a singleton pregnancy	E = 38 (31.6 ± 4.6 y), C = 37 (31.1 ± 5.2 y)	T: antenatal exercise (utilizing magnetic stationary bicycles); I: moderate; D: 16 weeks; F: 15–30 min per session, three to five sessions per week; f: NM	None	Without exercise intervention or provided with heart rate monitors	From 20 weeks of gestation	NM	WHOQOL-BREF	At baseline and the end of the intervention period	No significant between-group difference
Gustafsson, 2016	Norway	Healthy pregnant women with a singleton live birth during late pregnancy	E = 429 (30.5 ± 4.4 y), C = 426 (30.4 ± 4.3 y)	T: customized aerobic and strength exercises; D: 12 weeks; F: twice per week; f: group exercise	One weekly group session; written standardized information and recommendations on diet, pelvic floor muscle exercises and pregnancy-related pelvic girdle pain	Standard antenatal care, customary information; women were not discouraged from exercising	18–22 weeks of gestation	55%	PGWBI	At 18–22 and 32–36 weeks of pregnancy	No significant between-group difference
Haakstad, 2016	Norway	Previously sedentary, healthy nulliparous women	E = 52 (31.2 ± 3.7 y), C = 53 (30.3 ± 4.4 y)	T: supervised exercise (endurance training/aerobic and strength training); I: moderate; D: 12 weeks; F: at least 60 min of general fitness classes at least twice per week; at least two of three possible 1-h aerobic dance classes per week; f: group exercise	Each session was accompanied by music, and the exercise group was asked to include 30 min of moderate self-imposed physical activity on the remaining weekdays	Continued their usual physical activity habits	<24 weeks of gestation	80%	WHOQOL-BREF and SF-36	At 12–24 and 36–38 weeks of pregnancy	Improvements in the health satisfaction and fatigue domains
Watelain, 2017	France	Nulliparous women	E = 45 (29 ± 2 y), C = 45 (28 ± 3 y)	T: trunk exercise programme (aerobic and strength training); I: medium to moderate; D: 12 weeks; F: 60-min sessions twice per week; f: NM	None	Control group	24 weeks of gestation	NM	SF-36	At 24 and 36 weeks of pregnancy	Improvements in the physical function, bodily pain, role-physical, general physical health; vitality, social function, role-emotional and general mental health domains
O'Connor, 2018	USA	Pregnant women with LBP or a history of LBP	E = 44 (28 ± 5 y), e = 45 (29 ± 4 y), w = 45 (29 ± 4 y)	T: supervised resistance group exercise; I: low to moderate; D: 12 weeks; F: 17 min twice per week; f: individual or group exercise	None	e: six bimonthly pregnancy education classes (60 min each); w: control group	21–25 weeks of gestation (median 22)	82%	SF-36	At baseline and at the end of the intervention	Improvement in the vitality domain

E, exercise group; C, control group; e, education control group; w, wait list control group; y, year; w, week; D, duration; I, intensity; F, frequency; f, form; NM, not mentioned; BMI, body mass index; GDM, gestational diabetes mellitus; LBP, low back pain; SF-12, Colombian Version of the Medical Outcome Study Short-Form Health Survey; WHOQOL, World Health Organization Quality of Life; 15D, 15-Dimension Questionnaire; SF-36, Medical Study Short-Form Health Survey; PGWBI, Psychological General Wellbeing Index.

programme on the QoL of overweight/obese pregnant women, and found no significant improvement in the QoL scores of the participants in the exercise group. Petrov et al. [33] assessed the effects of supervised resistance training on the HRQoL of women pregnant with a singleton, and found no significant improvement in the QoL scores of the participants in the exercise group.

Combined exercise

Three studies [22,24,34] involving 1050 participants were analysed. Gustafsson et al. [22] used the Psychological General Wellbeing Index (PGWBI), Haakstad et al. [24] used a combination of the WHOQOL-BREF instrument and the SF-36, and Watelain et al. [34] used the SF-36.

Two [24,34] studies showed that combined exercise could significantly improve the QoL of pregnant women. Haakstad et al. [24] investigated the effect of combined exercise on the QoL of previously sedentary, healthy nulliparous women. After the intervention, the participants in the exercise group reported significantly higher scores in the health satisfaction and fatigue domains of QoL. Watelain et al. [34] evaluated the impact of a trunk-focused exercise programme that aimed to strengthen different muscle groups on nulliparous women's QoL. After the intervention, the participants in the exercise group reported significantly higher scores in the physical and mental component summaries of QoL. Additionally, Gustafsson et al. [22] explored the effect of customized antenatal exercise on the HRQoL of healthy pregnant women with a live singleton birth during late pregnancy. However, after the intervention, no significant improvement was observed in the QoL scores of the participants in the exercise group.

Yoga or PA

Three studies [3,30,32] involving 593 participants were analysed. Rakhshani et al. [30] used the WHOQOL instrument, Kolu et al. [3] used the 15-dimension questionnaire (15-D), and Claesson et al. [32] used the SF-36.

All three studies showed that yoga or PA can significantly improve pregnant woman's QoL. Rakhshani et al. [30] assessed the efficacy of the integrated approach of yoga (on the QoL of normal pregnant women), and confirmed that the participants in the exercise group reported significantly higher scores in the physical, psychological, social relationship, environmental and general health domains of QoL. Nevertheless, Claesson et al. [32] explored the impacts of moderate-intensity PA on the QoL of obese women (BMI $\geq$ 30 kg/m^2). After the intervention, the participants in the exercise group reported significantly higher scores in the social function, role limitation due to emotional problems and general mental health domains of the mental component summary; higher scores in the physical function and body pain domains of the physical component summary were also observed. Similarly, Kolu et al. [3] examined the impacts of leisure-time PA on the QoL of women with GDM factors, and reported that the participants in the exercise group had significantly higher scores in the mobility, sleep and usual activities domains of HRQoL.

Study quality

The risks of bias are shown in Table 2. After an independent evaluation by two researchers, the overall quality of the included studies was determined to be 'strong', whereas the quality of three studies was 'moderate' [12,23,24]. Due to the nature of the intervention, it was difficult for the interventionists and participants to be blinded, which somewhat reduced the quality of the included studies.

Discussion

This study is the first to systematically investigate the impact of aerobic exercise, resistance exercise, combined exercise, and yoga or PA on pregnant women's QoL. Thirteen studies were included and analysed. One of the three studies reported that aerobic exercise significantly improved pregnant women's QoL, and two of the four studies showed that resistance training could increase the QoL of pregnant women. Two of the three studies revealed that combined exercise improved pregnant women's QoL, and all three studies suggested that yoga or PA could positively affect the QoL of pregnant women. Although the results of various studies were mixed, overall, this review provides evidence that exercise is a viable, acceptable and effective intervention for increasing women's QoL during pregnancy.

Eight studies assessed the impact of exercise on QoL in overweight/obese or sedentary pregnant women and pregnant women with GDM or LBP. The participants in three studies [5,23,32] were overweight/obese pregnant women, and only Claesson et al. [32] showed significant differences between the comparison groups. Compared with the other two studies [5,23] that reported insignificant improvements, the participants in the study conducted by Claesson et al. [32] exercised for more time per week and exercised more intensively, and thus, the significant improvements could be explained by a dose–effect relationship. Meanwhile, the pregnant women's QoL was related to their body image [35], and overweight/obese pregnant women's body dissatisfaction may partially affect their QoL. Two studies [2,24] included sedentary pregnant women, and the study conducted by Haakstad et al. [24] demonstrated the effectiveness of exercise among sedentary pregnant women. When comparing the two studies [2,24], pregnant women in the study conducted by Vallim et al. [2] reported reduced adherence to the intervention (60% vs 80%). It is common for sedentary women to have low levels of adherence to exercise programmes [24]. Therefore, the adherence rate could better explain the differences between these two studies.

Table 2
Quality of included studies.

Author, year	Selection bias	Study design	Confounders	Blinding	Data collection methods	Withdrawals and drop-outs	Global rating
Montoya, 2010	Strong	Strong	Moderate	Moderate	Strong	Strong	Strong
Rakhshani, 2010	Moderate	Strong	Moderate	Moderate	Strong	Strong	Strong
Nascimento, 2011	Strong	Strong	Strong	Moderate	Strong	Strong	Strong
Vallim, 2011	Strong	Strong	Moderate	Moderate	Strong	Moderate	Strong
Kolu, 2014	Moderate	Strong	Strong	Moderate	Strong	Moderate	Strong
Claesson, 2014	Moderate	Strong	Moderate	Moderate	Strong	Strong	Strong
Akmese, 2014	Moderate	Strong	Moderate	Moderate	Strong	Strong	Strong
Petrov, 2014	Moderate	Strong	Strong	Moderate	Strong	Moderate	Strong
Seneviratne, 2016	Moderate	Strong	Strong	Weak	Strong	Strong	Moderate
Gustafsson, 2016	Strong	Strong	Strong	Moderate	Strong	Strong	Strong
Haakstad, 2016	Strong	Strong	Weak	Moderate	Strong	Strong	Moderate
Watelain, 2017	Moderate	Strong	Strong	Moderate	Strong	Strong	Strong
O'Connor, 2018	Moderate	Strong	Strong	Weak	Strong	Strong	Moderate

In addition, Kolu et al. [3] demonstrated that exercise was associated with positive benefits on the QoL of pregnant women with GDM. A systematic review [36] showed that GDM was a negative factor affecting the QoL of pregnant women, and that positive GDM-related self-management behaviours and healthy lifestyle behaviours, such as exercise, could improve the QoL of patients with GDM. Therefore, exercise is a feasible health-related approach that can significantly improve the QoL of pregnant women with GDM. The other two studies [12,31] confirmed the effectiveness of group-based exercise on QoL in pregnant women with LBP. On the one hand, previous studies have shown that exercise can improve LBP, which negatively affects the QoL of pregnant women, thus increasing their QoL [37]. On the other hand, group-based exercise provides the participants with more opportunities to share emotions and confusion, and facilitates communication, which could contribute to their adherence to the exercise programme [38]. In summary, exercise has potential positive effects on the QoL of pregnant women with different risk characteristics. Thus, medical providers should help pregnant women to develop healthy lifestyles, formulate targeted exercise measures, and avoid risk factors that may reduce the effects of exercise, which may be key to significantly improving their QoL.

Most studies have focused on the effects of exercise on improving both maternal and fetal health during the second and third trimesters, and there was a significant correlation between exercise and the QoL of pregnant women during the second and third trimesters [39]. However, few studies have examined women during the first trimester. In this review, only Kolu et al. [3] evaluated participants who exercised during the first trimester of pregnancy, and reported that their QoL improved significantly; participants in the other 12 studies included in this review began exercising during the second trimester and experienced mixed effects. An explanation for these findings may be that the physical, psychological and exercise changes experienced by pregnant woman during the first trimester were not significant compared with prepregnancy, and researchers and pregnant women do not pay enough attention to the benefits of exercise. In addition, fear of exercise risks, such as premature birth [40], may be the main reason why pregnant women are reluctant to participate in exercise at an early stage. A systematic review [41] suggested that the link between exercise during the first trimester and abortion has not been confirmed; thus, exercise in early pregnancy is still recommended. Therefore, strengthening the guidance and supervision of professional personnel to ensure the safety of exercise during the first trimester can improve pregnant women's exercise habits in early pregnancy, which is conducive to the discussion of the effects of long-term exercise during pregnancy on the improvement in QoL.

When exercising in groups, the participants were given more opportunities to experience emotional experiential exchanges and counselling. Five [3,12,24,29,31] of the seven studies reported that group exercise had a significant impact on pregnant women's QoL. Previous studies [42] have demonstrated that peer support is associated with QoL, indicating that group exercise is a contributing factor to improving pregnant women's QoL as it increases communication among participants and provides more emotional and psychological support [38]. Therefore, healthcare providers are advised to encourage pregnant women to participate in more social group-based exercise activities to maximize the effectiveness of exercise during pregnancy.

According to the calculated results, six studies reported exercise compliance with an average adherence rate of 69.08%, and thus, the actual impact of exercise on pregnant women's QoL could not be ascertained accurately. Of these six studies, three [12,24,29] showed higher adherence (82%, 80% and 75%) and three [2,5,22] showed lower compliance (60%, 62.5% and 55%). Consistently, the three studies demonstrating high adherence showed significant improvements in pregnant women's QoL, while the three studies with low adherence reported insignificant improvements. The compliance of pregnant women can significantly affect the ability of exercise to improve QoL. Possible factors that may affect pregnant women's adherence to exercise include later gestational age and exercise type [43]. In this case, high adherence to exercise was a key strategy for improving QoL. In addition, various exercise modalities and auxiliary strategies are important for increasing the compliance of pregnant women.

In addition to exercise, environmental and other factors, such as music, an air-conditioned room, an exercise diary and health counselling, may have potential benefits on pregnant women's QoL. For example, three studies [24,29,33] reported that participants listened to music while they exercised, and two of these studies [24,29] reported significant improvements in QoL. Music was viewed as a complementary and alternative therapy that improved the participants' emotional and mental health [31], which may have led to improvements in QoL. In addition, supervised exercise was used to promote compliance and was considered an encouragement strategy. The participants in five studies [5,12,24,29,33] exercised under the supervision of professionals, and three studies [12,24,29] reported a high adherence rate and positive improvements. Opportunities to interact and consult with professionals can increase a pregnant woman's interest in and motivation to participate in exercise programmes, thereby increasing the impact of exercise on their QoL. In summary, increasing the enjoyment of exercise, selecting comfortable exercise areas and increasing professional participation could encourage pregnant women to exercise. Therefore, the combination of these auxiliary strategies with exercise could help pregnant women adhere to exercise routines during pregnancy and have a better QoL.

As pregnancy progresses, pregnant women undergo many physical changes. Therefore, a customized exercise programme for pregnant women at different weeks of gestation may be more conducive to increasing their acceptance and adherence to exercise. In addition, it is recommended that healthcare providers should encourage pregnant women to perform group-based exercise during the early stages of pregnancy to improve their QoL as early as possible. Furthermore, various methods for assessing the QoL of pregnant women are evolving, increasing the difficulty in comparisons and analyses of the impact of exercise on QoL. Existing instruments are subjective assessment tools, and objective measurement variables, such as biomarkers, are still lacking. Therefore, future research should explore alternative or supplemental variables, such as exercise-QoL biomarkers, to quantitatively predict or evaluate QoL in pregnant women. In addition, previous studies have only explored the short-term effects of exercise on women's QoL during pregnancy, ignoring the long-term effects. Future research should focus on the implementation of follow-up and emphasize the importance of exercise to have a long-term impact on women's QoL during pregnancy.

Strengths and limitations

Notably, this review has some strengths. First, the types of research studies included were not limited to randomized controlled trials, and this review included controlled clinical trials to maximize the comprehensiveness of the results. Second, the research population was widely distributed and representative. Third, most participants exercised under the supervision of professionals or monitors, and thus, the results are more reliable. Fourth, the methodological quality of the research was mostly 'strong', improving the credibility of the research results.

However, this review also has some limitations. First, the participants analysed in this review included pregnant women in

healthy and special groups, and the actual results may differ. Second, due to the high heterogeneity among the included studies, it was difficult to aggregate the data and draw a quantitative conclusion. Third, the baseline QoL of the participants was challenging to compare, which could result in a larger QoL improvement in some pregnant women with ceiling or floor effects. Fourth, the number of included studies analysing the impact of each exercise type was limited, and thus, the specific results should be interpreted with caution.

Conclusions

In conclusion, the evidence available in this review suggests that high-frequency group-based exercise during pregnancy is beneficial for improving pregnant women's QoL. This review cannot provide a definitive conclusion regarding the best form of exercise, duration or timing for improving the QoL of pregnant women. However, combined (aerobic and resistance) exercise was found to effectively increase the QoL of pregnant women. More detailed and rigorous research is needed to strengthen the level of evidence supporting the benefits of exercise on pregnant women's QoL.

Conflict of interest

None declared.

Acknowledgement

This study was funded by the Chinese Postdoctoral Science Foundation (2016M601389).

References

[1] Taylor VR. Measuring healthy days; population assessment of health-related quality of life. Atlanta, GA: Centers for Disease Control and Prevention; 2015.
[2] Vallim AL, Osis MJ, Cecatti JG, Baciuk EP, Silveira C, Cavalcante SR. Water exercises and quality of life during pregnancy. Reprod Health 2011;8:14.
[3] Kolu P, Raitanen J, Luoto R. Physical activity and health-related quality of life during pregnancy: a secondary analysis of a cluster-randomised trial. Matern Child Health J 2014;18:2098–105.
[4] Chang SR, Chen KH, Lin MI, Lin HH, Huang LH, Lin WA. A repeated measures study of changes in health-related quality of life during pregnancy and the relationship with obstetric factors. J Adv Nurs 2014;70:2245–56.
[5] Nascimento S, Surita F, Parpinelli M, Siani S, Pinto ESJ. The effect of an antenatal physical exercise programme on maternal/perinatal outcomes and quality of life in overweight and obese pregnant women: a randomised clinical trial. BJOG 2011;118:1455–63.
[6] Kazemi F, Nahidi F, Kariman N. Exploring factors behind pregnant women's quality of life in Iran: a qualitative study. Electron Physician 2017;9:5991–6001.
[7] Lau Y, Htun TP, Lim PI, Ho-Lim SST, Chi C, Tsai C, et al. Breastfeeding attitude, health-related quality of life and maternal obesity among multi-ethnic pregnant women: a multi-group structural equation approach. Int J Nurs Stud 2017;67:71–82.
[8] Effati-Daryani F, Mirghafourvand M, Mohammad-Alizadeh-Charandabi S, Shiri-Sarand F, Zarei S. Sleep quality and its relationship with quality of life in Iranian pregnant women. Int J Nurs Pract 2017;23: Epub 2017 Jan 25.
[9] Glover V. Maternal depression, anxiety and stress during pregnancy and child outcome; what needs to be done. Best Pract Res Clin Obstet Gynaecol 2014;28:25–35.
[10] ACOG Committee Opinion No. 650. Physical activity and exercise during pregnancy and the postpartum period. Obstet Gynecol 2015;126:e135–42.
[11] Piercy KL, Troiano RP, Ballard RM, Carlson SA, Fulton JE, Galuska DA, et al. The physical activity guidelines for Americans. JAMA 2018;320:2020–8.
[12] O'Connor PJ, Poudevigne MS, Johnson KE, Brito de Araujo J, Ward-Ritacco CL. Effects of resistance training on fatigue-related domains of quality of life and mood during pregnancy: a randomized trial in pregnant women with increased risk of back pain. Psychosom Med 2018;80:327–32.
[13] Fazzi C, Saunders DH, Linton K, Norman JE, Reynolds RM. Sedentary behaviours during pregnancy: a systematic review. Int J Behav Nutr Phys Activ 2017;14:32.
[14] Bahadoran P, Mohamadirizi S. Relationship between physical activity and quality of life in pregnant women. Iran J Nurs Midwifery Res 2015;20:282–6.
[15] Perales M, Santos-Lozano A, Ruiz JR, Lucia A, Barakat R. Benefits of aerobic or resistance training during pregnancy on maternal health and perinatal outcomes: a systematic review. Early Hum Dev 2016;94:43–8.
[16] Hesketh KR, Evenson KR. Prevalence of U.S. Pregnant women meeting 2015 ACOG physical activity guidelines. Am J Prev Med 2016;51(3):e87–9.
[17] Mourady D, Richa S, Karam R, Papazian T, Moussa FH, El-Osta N, et al. Associations between quality of life, physical activity, worry, depression and insomnia: a cross-sectional designed study in healthy pregnant women. PLoS One 2017;12:e0178181.
[18] Campolong K, Jenkins S, Clark MM, Borowski K, Nelson N, Moore KM, et al. The association of exercise during pregnancy with trimester-specific and postpartum quality of life and depressive symptoms in a cohort of healthy pregnant women. Arch Women Ment Health 2018;21:215–24.
[19] Gong H, Ni C, Shen X, Wu T, Jiang C. Yoga for prenatal depression: a systematic review and meta-analysis. BMC Psychiatry 2015;15:14.
[20] Du MC Ouyang YQ, Nie XF, Huang Y, Redding SR. Effects of physical exercise during pregnancy on maternal and infant outcomes in overweight and obese pregnant women: a meta-analysis. Birth 2018, doi:http://dx.doi.org/10.1111/birt.12396.
[21] Almousa S, Lamprianidou E, Kitsoulis G. The effectiveness of stabilising exercises in pelvic girdle pain during pregnancy and after delivery: a systematic review. Physiother Res Int 2018;23:, doi:http://dx.doi.org/10.1002/pri.1699.
[22] Gustafsson M, Stafne S, Romundstad P, Morkved S, Salvesen K, Helvik A-S. The effects of an exercise programme during pregnancy on health-related quality of life in pregnant women: a Norwegian randomised controlled trial. BJOG 2016;123:1152–60.
[23] Seneviratne SN, Jiang Y, Derraik JGB, McCowan LME, Parry GK, Biggs JB, et al. Effects of antenatal exercise in overweight and obese pregnant women on maternal and perinatal outcomes: a randomised controlled trial. BJOG 2016;123:588–97.
[24] Haakstad L, Torset B, Bø K. What is the effect of regular group exercise on maternal psychological outcomes and common pregnancy complaints? An assessor blinded RCT. Midwifery 2016;32:81–6.
[25] Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. PLoS Med 2009;6:e1000097.
[26] Saligheh M, Hackett D, Boyce P, Cobley S. Can exercise or physical activity help improve postnatal depression and weight loss? A systematic review. Arch Women Ment Health 2017;20:595–611.
[27] Wolin KY, Schwartz AL, Matthews CE, Courneya KS, Schmitz KH. Implementing the exercise guidelines for cancer survivors. J Support Oncol 2012;10:171–7.
[28] Jackson N, Waters E. Criteria for the systematic review of health promotion and public health interventions. Health Promot Int 2005;20:367–74.
[29] Montoya Arizabaleta AV, Orozco Buitrago L, Cecilia Aguilar de Plata A, Mosquera Escudero M, Ramirez-Velez R. Aerobic exercise during pregnancy improves health-related quality of life: a randomised trial. J Physiother 2010;56:253–8.
[30] Rakhshani A, Maharana S, Raghuram N, Nagendra H, Venkatram P. Effects of integrated yoga on quality of life and interpersonal relationship of pregnant women. Qual Life Res 2010;19:1447–55.
[31] Akmese Z, Oran N. Effects of progressive muscle relaxation exercises accompanied by music on low back pain and quality of life during pregnancy. J Midwifery Womens Health 2014;59:503–9.
[32] Claesson I-M, Klein S, Sydsjo G, Josefsson A. Physical activity and psychological well-being in obese pregnant and postpartum women attending a weight-gain restriction programme. Midwifery 2014;30:11–6.
[33] Petrov FK, Glantz A, Fagevik OM. The efficacy of moderate-to-vigorous resistance exercise during pregnancy: a randomized controlled trial. Acta Obstet Gynecol Scand 2014;94:35–42.
[34] Watelain E, Pinti A, Doya R, Garnier C, Toumi H, Boudet S. Benefits of physical activities centered on the trunk for pregnant women. Phys Sportsmed 2017;45:293–302.
[35] Calou CGP, de Oliveira MF, Carvalho FHC, Soares P, Bezerra RA, de Lima SKM, et al. Maternal predictors related to quality of life in pregnant women in the Northeast of Brazil. Health Qual Life Outcomes 2018;16:109.
[36] Marchetti D, Carrozzino D, Fraticelli F, Fulcheri M, Vitacolonna E. Quality of life in women with gestational diabetes mellitus: a systematic review. J Diabetes Res 2017;2017:7058082.
[37] Backhausen MG, Tabor A, Albert H, Rosthoj S, Damm P, Hegaard HK. The effects of an unsupervised water exercise program on low back pain and sick leave among healthy pregnant women – a randomised controlled trial. PLoS One 2017;12:e0182114.
[38] Cai H, Li G, Zhang P, Xu D, Chen L. Effect of exercise on the quality of life in type 2 diabetes mellitus: a systematic review. Qual Life Res 2017;26:515–30.
[39] Krzepota J, Sadowska D, Biernat E. Relationships between physical activity and quality of life in pregnant women in the second and third trimester. Int J Environ Res Public Health 2018;15: pii E2745.
[40] Madsen M, Jorgensen T, Jensen ML, Juhl M, Olsen J, Andersen PK, et al. Leisure time physical exercise during pregnancy and the risk of miscarriage: a study within the Danish National Birth Cohort. BJOG 2007;114:1419–26.
[41] Hegaard HK, Ersboll AS, Damm P. Exercise in pregnancy: first trimester risks. Clin Obstet Gynecol 2016;59:559–67.
[42] Gul B, Riaz MA, Batool N, Yasmin H, Riaz MN. Social support and health related quality of life among pregnant women. J Pak Med Assoc 2018;68:872–5.
[43] Yeo S, Cisewski J, Lock EF, Marron JS. Exploratory analysis of exercise adherence patterns with sedentary pregnant women. Nurs Res 2010;59:280–7.