資料

Effects of Antenatal Exercise on the Quality of Life in Pregnant Women: A Literature Review

妊娠期のエクササイズによる妊婦のQOL：文献検討

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Abstract　Background: Antenatal exercise is considered to have both physical and psychological effects and helps prepare pregnant women for labour. This study aims to examine the evidence indicating that antenatal physical exercise improves the quality of life (QOL) in pregnant women.

Methods: We conducted a literature review and meta-analysis of randomised controlled trials (RCTs) using the Patient Intervention Comparison Outcomes (PICO) strategy to construct the following research question: In pregnant women (Patient), do physical antenatal exercises (Intervention) improve the QOL (Outcomes) when compared to routine daily activities, including suitable general physical activity (Comparison)? We searched the Cochrane Library, Cumulative Index to Nursing and Allied Health Literature (CINAHL), and PubMed for studies published before July 2016.

Results: We identified nine RCTs, two of which were included in our meta-analysis. The nine identified studies included 1,376 pregnant women, most of whom were in normal health. Of the nine RCTs, three showed statistically significant improvement in the 36-Item Short Form Health Survey Physical Function and General Health subscales. Two RCTs involving 154 women with a body mass index over 25 or 26 kg/m^2 were used for the meta-analysis. Our analysis showed a trend towards the intervention groups having higher scores in the World Health Organisation Quality of Life-BREF (WHOQOL-BREF) Psychological and Environmental domains than the control groups.

Conclusions: Physical and Psychological domains of the QOL measurements showed statistically significant improvement in antenatal exercise intervention groups using relaxation techniques. However, a previous meta-analysis found no evidence of improvement in four WHOQOL-BREF domains. There were many interventional methods in the nine RCTs included; therefore, the relationship between enhancement of QOL and relaxation techniques is unclear.

Keywords　Antenatal exercise, Pregnant women, Quality of life, Review

I. Background

In recent decades, developed countries have experienced a decline in the number of births. With the declining birth rate in recent years, pregnancy, delivery, and the postpartum period are precious experiences that women can have once or twice in their life. During pregnancy, major physical changes occur as foetal

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growth commences. Antenatal care is needed to ensure safe delivery and to enhance positive experiences of giving birth and parenthood. It is important for women to physically, psychologically, and socially prepare for birth at an individual level. An antenatal education programme or standardised individual care that has been evaluated for its psychological positive effects on quality of life (QOL) (Mogos et al., 2013), self-evaluation (Serçekuş and Mete, 2009), and self-efficacy (Lowe, 1993) may promote the health behaviour of women.

The World Health Organisation (WHO) defines QOL as an individuals' perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards, and concerns (WHO, 1997, p1). This definition correlates the physical, psychological, and social meanings of satisfaction with health and well-being (Mogos et al., 2013). A previous study investigated the effects of antenatal exercise on obese women during the prenatal period and measured their QOL on the basis of the World Health Organisation Quality of Life-BREF (WHOQOL-BREF); this means that the outcomes included physical factors such as weight gain and birth outcomes as well as psychological and social/environmental effects (Seneviratne et al., 2014).

Exercise during pregnancy is considered to have physical and psychological effects and helps prepare pregnant women for labour. A historical overview of physical activity over 500 years showed an association between active work and a comfortable childbirth; this is also supported by research findings (Rankin et al., 2000). Since then, many studies have evaluated the effects of antenatal exercise. Physical effects include significant relief from back pain and constipation (Shendkar and Kodhare, 2015), non-pharmacological effects (avoiding complications in childbirth) (Lawani et al., 2003), fewer caesarean sections (Dumith et al., 2012), and lower occurrence of still births (Dumith et al., 2012). However, there were no statistically significant physical effects for low back pain and pelvic girdle pain (Eggen et al., 2012), abnormal foetal growth restriction (Tomic et al., 2013) and birth outcomes (Miquelutti et al., 2013). Some studies reported psychological effects, with antenatal yoga practice found to reduce depressive symptoms and improve mood (Uebelacker et al., 2016; Gong et al., 2015). Miquelutti et al. (2013) reported that attending a birth preparation programme showed no significant effect on anxiety. Other trials did not show clear psychological effects of antenatal exercise. One study reported social effects in terms of cost-effectiveness (Oostdam et al., 2012). QOL measurements generally encompass both physical and psychological domains (Mogos et al., 2013; Skevington et al., 2004). QOL outcomes during the antenatal period also emphasise the importance of pregnancy and satisfaction of women's expectations.

The purpose of this review was to examine the evidence indicating that antenatal physical exercise may improve the QOL of pregnant women. Our findings may be integral for midwifery care.

II. Methods

1. Research question and eligibility criteria

This literature review was based on the recommendations of the Cochrane Handbook for Systematic Reviews of Interventions (Cochrane Collaboration, 2011) and used the Patient Intervention Comparison Outcomes (PICO) strategy to construct the following research question: In pregnant women (Patient), do physical antenatal exercises (Intervention) improve the QOL (Outcomes) when compared to routine daily activities, including suitable general physical activity (Comparison)?

Our inclusion criterion was randomised controlled trials (RCTs) with antenatal women who were randomised into exercise and control groups. Interventions included a range of physical exercise, such as yoga, aerobics, swimming, walking and pelvic floor

exercises. There were no restrictions on control groups. Therefore, any trial that compared an exercise intervention with usual, standard prenatal care and social support was eligible.

2. Search strategy

We searched three electronic databases: the Cumulative Index to Nursing and Allied Health Literature (CINAHL), the Cochrane Library and PubMed. There were no restrictions regarding the date of publication or language. We used the following search terms: 'quality of life'; 'psychological' including 'self-efficacy', 'self-esteem,' and 'spontaneity'; 'mood'; 'antenatal or prenatal'; 'pregnancy'; 'antenatal care'; 'exercise'; and 'maternity exercise' including 'gymnastics', 'yoga', 'aerobics', 'swimming', 'walking', and 'pelvic floor exercises'.

3. Data collection

Data were extracted by three authors. First, each paper was independently screened using its title and abstract. We excluded reviews; study protocols; and qualitative, no-intervention, and no-comparison studies. Next, studies were assessed for inclusion in terms of results and quality by two authors. Finally, full texts were discussed by all authors to reach consensus. We excluded non-randomised studies, studies in which no QOL was measured, and studies in which only the postnatal period and postnatal intervention were measured. The extracted information included year of publication, nationality, number of participants analysed, age and gestation of the participating pregnant women, risk of pregnancy, QOL measurement before and after the intervention, intervention programme, statistical information, and intervention results.

4. Quality assessment

All authors independently assessed the quality of the included studies. This quality assessment was based on the Cochrane Library's 2011 handbook. Assessment included methods of randomisation, allocation concealment, and blinding and how incomplete data were addressed. Randomisation was rated as appropriate if the pregnant women had been equally selected. Allocation was assessed as adequate, unclear, or inadequate; adequate was defined as a method that included randomisation, serial numbering, and sealed envelopes. Blinding was assessed as 'yes', 'no', or 'unclear' as it pertained to actual outcomes. Each study was also rated based on numbers of and reasons for dropouts. The Jadad Score was used for the quality assessment of bias risk (Jadad et al., 1996). This score uses a three-item, five-point quality scale for randomisation, double-blind design, participant withdrawals, and dropout description. The maximum possible score is 5. High quality is defined as a score of 3 points or more (Jadad et al., 1996).

5. Data synthesis and statistical analysis

The main measure of effect for the meta-analysis was the standard mean difference (MD). Most studies reported pre-intervention and post-intervention MDs, and the final data were used for our analysis. The data synthesis and calculation formula were based on the Cochrane methodology (Cochrane handbook, 2011). The meta-analysis was conducted using the Review Manager 5 software for Windows (Version 5.3, Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration, 2014). For continuous outcomes, we calculated MDs with 95% confidence intervals (CIs). The level of statistical significance was set at $p < 0.05$. A fixed effect model was used to calculate I-square (I^2) to test for heterogeneity. Differences between the intervention and control groups were calculated and assessed. An I^2 value of more than 50% indicated significant heterogeneity.

III. Results

1. Study characteristics

The study selection process is outlined in Figure 1. Selected studies are summarised in Table 1.

Of the 137 identified articles, we included nine RCTs

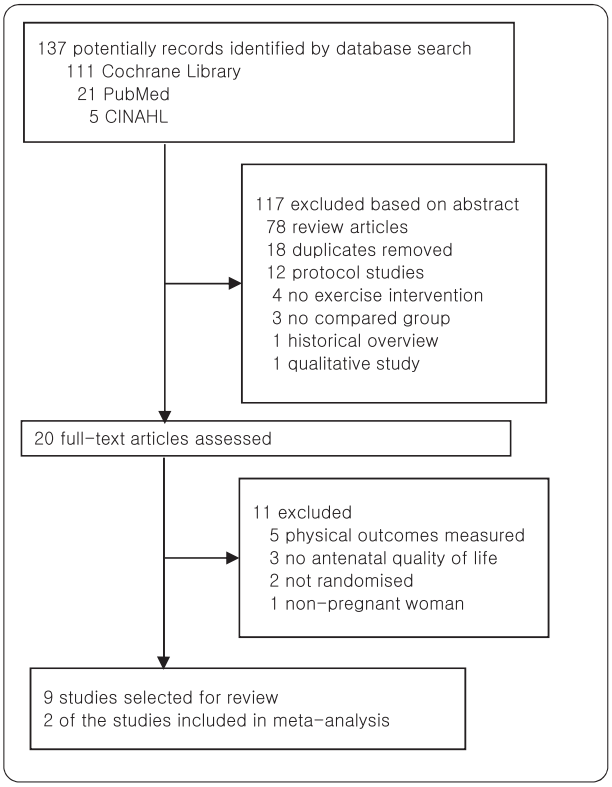

Figure 1　Flow diagram of study selection.

in our analysis. The remaining 128 articles were excluded because they were review articles (n＝78) or study protocols (n＝12). In total, the full texts of 20 studies were read and assessed. Of them, five only measured physical outcomes (no psychological outcomes), three did not measure QOL, two did not describe randomisation, and one investigated outcomes for postpartum women. Therefore, 11 articles were excluded in total.

Table 1 presents an outline of the nine included RCTs. In total, 1,376 pregnant women were included in these studies. All nine RCTs were published in the last 6 years. Two RCTs included women with a body mass index (BMI) of ≥25 or 26 kg/m^2 (Seneviratne et al., 2015; Nascimento et al., 2011), while the other seven trials enrolled women with normal BMIs.

Three RCTs used standard exercises (Gustafsson et al., 2015; Nascimento et al., 2011; Montoya et al., 2010), and the others used resistance training (Fieril et al., 2015), magnetic stationary bicycles (Gustafsson et al., 2015), progressive muscle relaxation (PMR) (Akmeşe and Oran, 2014), aerobic dance (Lene et al., 2016), aerobic water exercise (Vallim et al., 2011), or yoga (Rakhshani et al., 2010). These antenatal exercises included a warm-up; stretching and relaxation of abdominal, pelvic floor, back, and neck muscles; breathing; and a cool-down at a moderate intensity (Akmeşe and Oran, 2014; Lene et al., 2016; Montoya et al., 2010; Nascimento et al., 2011; Rakhshani et al., 2010). In the intervention group, pregnant women participated in approximately 1 hour exercise classes (Fieril et al., 2015; Gustafsson et al., 2015; Lene et al., 2016; Montoya et al., 2010; Rakhshani et al., 2010; Vallim et al., 2011) or individual, daily home-based training (Akmeşe and Oran, 2014; Nascimento et al., 2011; Seneviratne et al., 2015). Two RCTs with individual exercises included the options of home-exercise counselling (Nascimento et al., 2011) and educational intervention (Akmeşe and Oran, 2014). Most RCTs began their interventions between 12 and 20 weeks of gestation.

Measures of QOL included the WHOQOL-BREF (Lene et al., 2016; Seneviratne et al., 2015; Nascimento et al., 2011; Vallim et al., 2011), the WHOQOL-100 (Rakhshani et al., 2010), the 36-Item Short Form Health Survey (SF-36) (Lene et al., 2016; Fieril et al., 2015; Akmeşe and Oran, 2014), the 12-Item Short Form Health Survey (SF-12) (Montoya et al., 2010), and the Psychological General Well-being Index (Gustafsson et al., 2015).

2. Quality of included studies

Most trials were of moderate quality (Jadad Score between 2 and 4). All studies included randomly assigned groups and described the randomisation method. Four RCTs reported the reason for dropout in each group (Fieril et al., 2015; Gustafsson et al., 2015; Nascimento et al., 2011; Montoya et al., 2010). Seven RCTs adequately reported the method of allocation concealment, mostly using sealed envelopes. Three RCTs

Table 1 Characteristics of the randomised clinical trials on exercise in pregnant women.

Author (Country)	Participant/ setting	Sample size	Interventions	Outcome measures	Main findings on QOL
Lene et al., 2016 (Norway)	Nulliparous healthy weight pregnant women between 12 and 24 weeks of gestation and at gestation weeks 36–38 (after the intervention)	105 analysed: 52 in the exercise group, 53 in the control group	Participation in at least two out of three possible one hour aerobic dance classes per week for minimum of 12 weeks	Quality of life (WHOQOL-bref and 36-Item Short Form Health Survey: SF-36), well-being, body image, and negative symptoms/maternal depression	No statistically significant differences in quality of life. Statistically significantly higher in health satisfaction. Statistically significant reduction in fatigue
Fieril et al., 2015 (Sweden)	Pregnancy < 14 weeks of gestation, single pregnancy, absence of medical or obstetric diseases, and ability to understand verbal and written Swedish/antenatal clinic based	72 analysed: 38 in the intervention group, 34 in the control group	Participation in high-repetition resistance training twice a week for 12 weeks (pregnancy weeks 14–25)	Quality of life (HRQoL using the SF-36, Swedish Acute Version 1.0)	No statistically significant differences in HRQoL
Gustafsson et al., 2015 (Norway)	Healthy Caucasian pregnant women 18 years or older with a singleton live foetus/hospital based	761 analysed: 396 in the intervention group, 365 in the control group	Exercise three times a week for 12 weeks (between 20 and 36 weeks of pregnancy) following a standardised exercise programme	Health-Rated Quality of life (HRQoL) using the Psychological General Well-being Index (PGWBI) questionnaire, which measures psychological well-being and self-perceived general health	No substantial difference in general health perception or psychological well-being in the third trimester
Seneviratne et al., 2015 (New Zealand)	Pregnant women aged 18–40 years with a body mass index (BMI) ≥ 25 kg/m^2 and a singleton pregnancy of < 20 weeks of gestation/home based	74 analysed: 37 in the intervention group, 37 in the control group	Participation in a home-based moderate-intensity antenatal exercise programme utilising magnetic stationary bicycles from 20 to 35 weeks of gestation	Health-Related Quality of Life (WHOQOL-BREF), birthweight, pregnancy and birth outcomes, and pregnancy physical activity (PPAQ)	No statistically significant differences in WHOQOL-BREF
Akmese and Oran, 2014 (Turkey)	Pregnant women aged 20 to 35 years, presence of low back pain (LBP) diagnosed by a physician with no history of LBP or lumbar pathology before pregnancy, visual analog scale (VAS) score of 4 or greater/home based	66 analysed: 33 in the Progressive Muscle Relaxation (PMR) group, 33 in the control group	Participation in 2 hours of education to learn and perform the exercise properly and performance of PMR exercise twice per day (morning and evening) for 8 weeks	Quality of life (SF-36) and VAS scale for measuring LBP	Statistically significant improvement in SF-36 subscales: Physical Function, Role Physical, Body Pain, General Health, Vitality, Social Function, Role Emotional, and Mental Health
Nascimento et al., 2011 (Brazil)	Pregnant women age ≥ 18 years with a BMI ≥ 26 kg/m^2 and gestational age of 14 – 24 weeks/home based	80 analysed: 39 in the study group, 41 in the control group	Exercise under supervision and receive home exercise counselling. The protocol consisted of light-intensity to moderate-intensity exercises	Quality of life (WHOQOL-BREF), gestational weight gain, blood pressure, and perinatal outcomes	No statistically significant differences in WHOQOL-BREF
Vallim et al., 2011 (Brazil)	Sedentary pregnant women with low-risk singleton pregnancies of ≤ 20 weeks/public health service based	66 analysed: 31 in the water aerobics group, 35 in the control group	Participation in 50-minute water aerobics classes held three times weekly in an indoor pool heated to 28–30 ℃	Quality of life (WHOQOL-BREF)	No statistically significant differences in WHOQOL-BREF
Montoya et al., 2010 (Colombia)	Nulliparous pregnant women aged between 16 and 30 years, between 16 and 20 weeks of gestation, with a live foetus at a routine ultrasound scan/hospital based	50 analysed: 24 in the experimental group, 26 in the control group	Participation in three 60-min exercise classes per week starting between week 16 and 20 of gestation and continuing for 3 months	Health-Rated Quality of Life (12-Item Short Form Health Survey: SF-12)	Statistically improvement in Physical Component, Physical Function, Bodily Pain, and General Health. However, no statistically significant difference in Mental Component
Rakhshani et al., 2010 (India)	Normal pregnancies that were either primigravida or multigravida with at least one living child, at 18–20 weeks of gestation, between 20 and 35 years of age	102 analysed: 51 in the yoga group, 51 in the control group	Participation in 1-h yoga sessions with trained instructors 3 days per week for the first month. Thereafter, continuing the respective practices at home until delivery	Quality of life (WHOQOL-100) and Fundamental Interpersonal Relations Orientation (FIRO-B questionnaire)	Statistically improvement in Physical, Psychological, Social Relationships, Environment, and General Health quality. No statistically significant differences in the Independence and Spirituality domains

included investigators who were blinded to participant groups or outcomes (Lene et al., 2016; Fieril et al., 2015; Montoya et al., 2010).

3. Effects of antenatal exercise on QOL of pregnant women

Of the nine RCTs, three showed statistically significant post-intervention improvements (Akmeşe and Oran, 2014; Montoya et al., 2010; Rakhshani et al., 2010) (Table 1). Akmeşe and Oran (2014) provided 2 hours of individual educational intervention and 20 minutes of home-based PMR exercises twice a day for women with a diagnosis of lower back pain. Akmeşe and Oran (2014) reported statistically significant improvements in all eight SF-36 subscales ($p < 0.001$). Montoya et al. (2010)

used group-based exercise consisting of 10 minutes of walking, 30 minutes of aerobics, 10 minutes of stretching, and 10 minutes of relaxation once a week with moderate to vigorous intensity for normal pregnant women. This trial found significant improvements in the SF-12 Physical Function (MD＝46.0, 95% CI 33.0－56.0), Body Pain (MD＝52.0, 95% CI 45.0－59.0), and General Health (MD＝55.0, 95% CI 47.0－63.0) subscales. One RCT using the WHOQOL-100 (Rakhshani et al., 2010) provided a home-based daily yoga exercise programme with 10 minutes of breathing, 15 minutes of poses and 20 minutes of meditation for normal pregnant women. They found significant improvements in five WHOQOL-100 domains: Physical (MD＝15.79, 95% CI 15.0－16.57; p＝0.001), Psychological (MD＝16.08, 95% CI 15.0－16.57; p＝0.001), Social Relationships (MD＝16.88, 95% CI 16.34－17.42; p ＝ 0.003), Environment (MD＝16.25, 95% CI 15.69－16.82; p＝0.001), and General Health (MD＝17.08, 95% CI 16.43－17.73; p＝0.001) (Rakhshani et al., 2010).

There were no statistically significant differences in the four RCTs that used the WHOQOL-BREF (Lene et al., 2016; Seneviratne et al., 2015; Nascimento et al., 2011; Vallim et al., 2011). Two RCTs showed a trend toward improvement for both groups in three WHOQOL-BREF domains: Overall satisfaction, QOL, and Environment. In contrast, the Physical domain showed a

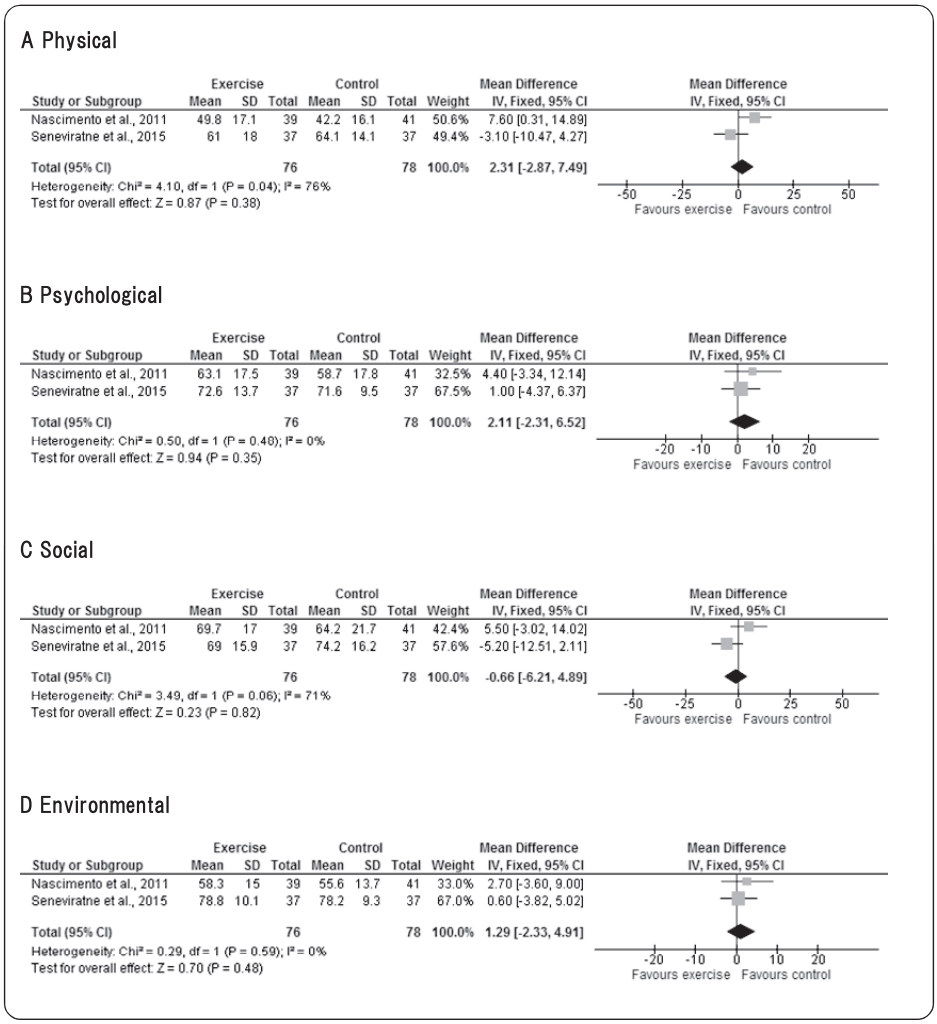

Figure 2　Forest plots of randomised trials of effects of exercise on four the World Health Organisation Quality of Life-BREF (WHOQOL-BREF) domains for pregnant women: intervention and control groups.

reduced trend from before to after the intervention (Nascimento et al., 2011; Vallim et al., 2011).

4. Meta-analysis

Comparisons of two RCTs were practicable for the meta-analysis (Seneviratne et al., 2015; Nascimento et al., 2011). Both RCTs used four WHOQOL-BREF domains (Figure 2). There was a trend toward the intervention groups showing higher scores for the Psychological domain (MD＝2.11, 95% CI－2.31－6.52; I^2＝0%) and the Environmental domain (MD＝1.29, 95% CI－2.33－4.91; I^2＝0%) than the control groups. There was significant heterogeneity in the Physical (MD ＝2.31, 95% CI－2.87－7.49; I^2＝76%; p＝0.04) and Social (MD＝－0.66, 95% CI－6.21－4.89; I^2＝71%; p ＝0.06) domains. The results of this meta-analysis demonstrated no evidence for statistically significant improvement in the four domains in the intervention groups (Figure 2).

IV. Discussion

1. Implications for the effect of antenatal exercise on QOL

Antenatal physical exercise that included yoga or PMR for pregnant women significantly improved the Physical and Psychological WHOQOL-BREF domains (Akmeşe and Oran, 2014; Montoya et al., 2010; Rakhshani et al., 2010). Yoga (Rakhshani et al., 2010) and PMR (Akmeşe and Oran, 2014) were designed to use relaxation techniques during seven other trials and included a small amount of relaxation during warm-up and cool-down sessions. In three RCTs, participants were women with normal health (Montoya et al., 2010; Rakhshani et al., 2010) or women with a diagnosis of lower back pain (Akmeşe and Oran, 2014). For the women with symptoms of lower back pain, exercises comprising stretching and relaxation released muscle tension, thereby, alleviating lower back pain and physical effects. Montoya (2010, p257) suggested that antenatal symptoms such as body pain seemed to be more closely associated with physical activity. For improving the Psychological domain, relaxation exercises (Akmeşe and Oran, 2014) and breathing and meditation after yoga poses (Rakhshani et al., 2010) were considered to cause somatic restfulness and parasympathetic dominance, thereby, reducing anxiety and pain, and releasing endorphins (Akmeşe and Oran, 2014). A systematic review of yoga in pregnancy based on psychotherapy suggested that yoga may be effective in reducing depressive symptoms (Gong et al., 2015). Therefore, these studies demonstrated that antenatal exercises with relaxation help relieve both psychological and physical symptoms in pregnant women. However, the nine trials included had nine different exercise interventions; thus, the relationship between enhancement of QOL and relaxation techniques remains unclear. Moreover, more RCTs with unified exercises and control groups are necessary for comparison. In one study, women were provided with individual education (Akmeşe and Oran, 2014), which influenced not only the exercise method but also knowledge of exercise evidence related to psychological effects on QOL. However, only three RCTs with relatively small sample sizes (218 participants in total) showed statistically significant improvements, and those studies had moderate quality of blinding and had addressed incomplete data. More RCTs of interventions for normal pregnant women are necessary.

In six trials, no significant improvement in QOL was found (Fieril et al., 2015; Gustafsson et al., 2015; Lene et al., 2016; Nascimento et al., 2011; Seneviratne et al., 2015; Vallim et al., 2011). Lene et al. (2016), Gustafsson et al. (2015) and Seneviratne et al. (2015) indicated low adherence or compliance with the exercise protocol as a reason. Low adherence or compliance was possibly due to the high level of physical activities, such as moderate-to-vigorous resistance (Fieril et al., 2015). The interventions used in these trials were not considered to have any significant impact on the measurement of QOL.

The nine studies included in this review had various types of antenatal exercises: aerobic dance, aerobic water exercise, resistance training, PMR, and yoga. Additionally, several of the studies had intervention methods including a warm-up; stretching and relaxation of the abdominal, pelvic floor, back, and neck muscles; breathing; and a cool-down. Eight trials were considered to use common light-to-moderate intensity exercise (Akmeşe and Oran, 2014; Gustafsson et al., 2015; Lene et al., 2016; Montoya et al., 2010; Rakhshani et al., 2010; Nascimento et al., 2011; Seneviratne et al., 2015; Vallim et al., 2011).

Three trials used hospital group-based educational classes (Fieril et al., 2015; Montoya et al., 2010; Vallim et al., 2011), and three used home-based exercises (Akmeşe and Oran, 2014; Nascimento et al., 2011; Seneviratne et al., 2015). Vallim et al. (2012, p6) indicated that the participants of the study were receiving prenatal care at the teaching hospital. The quality of the services of this hospital is recognized throughout the region; therefore, the participants were considered to have higher social or environmental scores. Compared with hospital group-based educational classes, home-based exercises were considered to be easier to incorporate in an individual's daily routine (Seneviratne et al., 2015), which also affects the individual's condition. Both setting have possibilities for improving the fitness of women. However, it is difficult to explain their relationship with QOL.

The effects of antenatal exercise on WHOQOL-BREF domains were not significant in four RCTs (Lene et al., 2016; Seneviratne et al., 2015; Nascimento et al., 2011; Vallim et al., 2011). However, two of the trials showed a trend towards improvement in Overall satisfaction, QOL, and Environment factors (Nascimento et al., 2011; Vallim et al., 2011). The results might have been affected by the study purpose of reducing gestational weight gain (Nascimento et al., 2011) or by social relationships in group exercise (Vallim et al., 2011). The WHOQOL physical-domain questionnaire includes 'pain and discomfort' (Seneviratne et al., 2014) and considers relationships with reduction of lower back and pelvic girdle pain symptoms. In the psychological domain, the questionnaire includes 'positive feelings' (Seneviratne et al., 2014) and considers the relationship between relaxation exercises and the reduction of anxiety. Subgroup analysis in this review was necessary to take into account normal and obese pregnant women, and individual- and group-based exercise interventions; however, there were few studies to compare. More trials are necessary to make such comparisons.

All RCTs started exercise between 12 and 20 weeks of gestation. It is desirable for pregnant women to start exercising in their early pregnancy in terms of an educational intervention, because they can have the time to be provided with sufficient knowledge. This consequently enables them to engage in long-term exercise during gestation period.

A previous meta-analysis found no evidence of improvement in four WHOQOL-BREF domains (Seneviratne et al., 2015; Nascimento et al., 2011). However, both the Psychological and Environmental domains showed trends toward improvement in the intervention groups, with low heterogeneity ($I^2 = 0\%$). However, only two trials were eligible for meta-analysis. Therefore, the outcomes of the four domains of the WHOQOL-BREF need to be interpreted with caution. More studies using QOL measurements are necessary.

2. Quality of the evidence

The selected studies were of moderate quality, and only two trials provided details regarding the methods of randomisation, allocation concealment, and blinding, and how incomplete data were addressed (Fieril et al., 2015; Montoya et al., 2010). Of those two studies, only one (Montoya et al., 2010) reported significant improvement of QOL. However, as there were a limited number of trials, additional methodological information from the reviewed studies is necessary. The quality of evidence

from the other trials we reviewed was moderate to poor because of the high risk of bias and unknown dropout rates.

3. Strengths and limitations

The strength of this review is its investigation into the possibility of improving QOL from the viewpoint of different types of antenatal exercises and interventional methods. This review clarified the necessity for more RCTs concerned with not only exercise but also individual educational interventions. We found that QOL was generally measured with four tools: the WHOQOL-BREF, the WHOQOL-100, the SF-36, and the SF-12. These scales, particularly the WHOQOL, can be used in cross-cultural settings and for a wide range of health conditions (Skevington et al., 2004). In a systematic review of health-related QOL literature in pregnant and postnatal women, Mogos et al. (2013, p9) described a lack of measurement scales designed specifically for use in the general maternity care setting. In our search, there were no trials using scales specific to maternity. This highlights the need for a specific QOL scale for antenatal women.

This study had several limitations. First, the search was conducted using only three electronic databases. However, the Cochrane Library has many review articles; these reviews were helpful in locating other trials. Second, the included studies had a variety of intervention methods, settings, and measurements, which restricted subgroup analysis. Therefore, further research that includes unpublished antenatal exercise studies and uses a manual search strategy is necessary.

V. Conclusions

Overall, we found that the Physical domain of the WHOQOL-BREF showed statistical improvement in the antenatal exercise intervention groups. There were no significant effects on the WHOQOL-BREF Psychological, Social, and Environmental domains. However, our meta-analysis showed trends toward improvement in the intervention groups in the Psychological and Environmental domains. The purpose of the exercise was improvement of physical fitness and well-being in most of the included studies. However, there were many interventional methods in the nine included RCTs. This review suggests that interventions with both education and exercise comprising stretching and relaxation techniques should be implemented starting in the first trimester of pregnancy. It would be helpful to explore the most effective exercise methods for improving QOL. Evaluation of QOL is relatively complex and difficult, and more trials which have similar purposes are necessary to provide evidence as to the effect of antenatal exercise.

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