

# A Narrative Review of Physical Activity and Exercise during Pregnancy: Nurse's Role

Sirikanok Klankhajhon<sup>1</sup>  
Anonthasha Sthien<sup>2</sup>

<sup>1</sup> Faculty of Nursing, Naresuan University, Phitsanulok, Thailand  
<sup>2</sup> Instructor at Sirindhorn College of Public Health Phitsanulok, Phitsanulok, Thailand

\*Correspondence: Sirikanok Klankhajhon  
Faculty of Nursing, Naresuan University, Phitsanulok, Thailand  
Email: [sirikanok\\_k@hotmail.com](mailto:sirikanok_k@hotmail.com)

## ABSTRACT

Obesity is an important global health issues in pregnancy that impact on pregnant women and newborn such as gestational diabetes mellitus, and cardiovascular diseases. The scoping review six stages is used to review an exercise during pregnancy, which is associated to potential maternal and newborn's physical, psychological and social health aspects both short and long terms. The prescription of exercise during pregnancy for low risk pregnant women without any contraindications should take moderate level of exercise at least 3 times a week, at least 30 minutes or more of accumulated exercise a day, which include a 5-10 minutes warm up and cool down period, 20-30 minutes exercise from protocol: muscular workouts and/or cardiovascular training. Pregnant women should exercise as muscular workouts and cardiovascular training and unsafe activities should be avoided. Nurses' role support pregnant women to enhance knowledge of exercise and increase exercise behaviour during pregnancy through nursing process at antenatal care clinic.

**Keywords:** pregnant women; exercise; physical activity; pregnancy

## INTRODUCTION

Obesity and overweight (O&O) is an important global health problem. The Global Health Observatory (GHO) report indicated that the prevalence of global O&O is increasing continuously (The World Health Organization (WHO), 2015). including in Thailand (The Ministry of Public Health (MoPH), 2019). Obesity has direct and indirect impacts on physical and mental health, particularly in terms of high to extremely high risk of non-communicable diseases (NCDs) depending on level of obesity (Mahmood & Arulkumaran, 2013; Özdemir, 2015). NCDs are also known for leading to chronic illness composed of four main types: cardiovascular diseases, cancers, chronic respiratory diseases, and diabetes mellitus (The World Health Organization (WHO), 2015). In pregnant women, obesity and overweight may impact on maternal health and offspring outcomes, including both medical and obstetrical complications. Moreover, being obese is associated with next generation (The Centers for Disease

Volume 1(2), 49-60  
© The Author(s) 2022  
<http://dx.doi.org/10.55048/jpns.v1i2.16>

e-ISSN 2827-8100  
p-ISSN 2827-8496

Received : March 2, 2022  
Revised : March 16, 2022  
Accepted : March 27, 2022  
Published : May 5, 2022



This is an **Open Access** article distributed under the terms of the [Creative Commons Attribution-NonCommercial 4.0 International License](https://creativecommons.org/licenses/by-nc/4.0/).

Control and Prevention, 2012; Marchi et al., 2015), thereby compounding this public health issue for future generations. The evidence strongly supports the benefits of regular exercise during pregnancy, which increases physical fitness. Several studies show that exercise is associated with a decrease in the risk of NCDs and obstetrical complications, control of gestational weight gain, reduction in antenatal depression symptoms, reduced rates of macrosomia (a birth weight more than 4,000 grams) and reduced risk of the overweight offspring (Millard et al., 2013; Makinde et al., 2014; Seneviratne et al., 2014)

The Arksey and O'Malley methodological framework was applied in this scoping review about exercise in pregnancy. The process involved six stages: identifying the research question, identifying the relevant studies, selecting the relevant studies, charting the data, collecting summarising and reporting the results, and consulting (Arksey & O'Malley, 2005; Peters et al., 2015). A scoping search was undertaken on electronic databases as Medline (EBSCO), EMBASE, CINAHL, PsycINFO, and PubMed Central (PMC), from 2014 and updated in 2020. The search consisted of two concepts: exercise/physical activity; and pregnancy. For each concept, key words and MeSH terms were combined with the 'OR' operator and the results were combined with the 'AND' operator.

After identifying the studies, the study selection process was applied to decision making based on the quantity and quality of the studies, inclusion and exclusion criteria, study design, and key findings. The titles of articles were reviewed based on the inclusion and exclusion criteria indicating a target population, language, and scope of the study. Then, the selection process included reviews of abstracts and full-text articles under supervision of the consultant. In this scoping review, the quality assessment of the articles were assessed by using the assessment tool from the Critical Appraisal Skills Programme (CASP). Data were extracted from the studies using a data sheet about the study's author and year, study design, sample size and characteristics, data collection, and key findings. The findings from present study are summarised in accordance with the questions of this review. There were 1,054 articles from the search. 754 articles were removed after screening the title and abstract. 288 articles were excluded that did not meet the criteria about exercise or physical activity during pregnancy. 12 studies were

scoping review.

The worldwide level of exercise among pregnant women is low in both developed and developing countries (The Centers for Disease Control and Prevention, 2014); The National Heart Foundation of Australia, 2015; (The World Health Organization (WHO), 2015). Pregnant women typically had a lower level of exercise than they did during their pre-pregnancy life (Engberg et al., 2012; Currie et al., 2013; Nascimento et al., 2015). Only 8.4% of pregnant women remained active all three trimesters of pregnancy. The proportion of women who met the ACOG guidelines for exercise during pregnancy (>150 minutes of moderate intensity exercise per week) was lower: 7.2%, 7.6% and 4.7% in the first, second and third trimester, respectively (Nascimento et al., 2015). 11.1% of pregnant urban Chinese women met the ACOG guidelines (Zhang et al., 2014). Exercise during pregnancy declined from pre-pregnancy to after delivery due to avoiding any harm for their offspring, and changing the type of physical activity (Engberg et al., 2012).

### **Recommendation physical activity and exercise during pregnancy**

The World Health Organization (WHO) recommends for adults aged 18-64 years that they should engage at least 150 minutes of moderate intensity physical activity, or at least 75 minutes of vigorous intensity physical activity, or an equivalent combination of both moderate and vigorous intensity physical activity per week. The American College of Obstetricians and Gynecologists (2002) recommends that healthy pregnant women should engage an accumulated 30 minutes or more of moderate exercise a day on most days of the week (The American College of Obstetricians and Gynecologists, 2002); Artal et al., 2003). An updated version recommends that healthy pregnant women should take moderate intensity exercise at least 20-30 minutes a day on most or all days of the week.

The Royal College of Obstetricians and Gynaecologists (RCOG) recommends for previously inactive women or those starting exercise during pregnancy that women should begin moderate intensity exercise no more than 15 minutes at least three times a week and progress up to 30 minutes four times a week (The Royal College of Obstetricians and Gynaecologists, 2006). The American College

of Sports Medicine (ACSM) recommends that women with morning sickness in the first trimester should initially perform at least 10 minutes of moderate intensity exercise during pregnancy, progressing to up to 30 minutes a session, at least three times a week (The American College of Sports Medicine, 2014).

Exercise is a subcategory of physical activity. Physical activity is defined as “any bodily movement produced by skeletal muscles that result in energy expenditure” (Caspersen et al., 1985) which covers numerous activities of daily living such as activities for working, household working, child-care, playing, gardening, leisure-time activity/recreational activity, and stair climbing (WHO, 2014). While exercise is the leisure time physical activity, exercise refers to “planned, structured, repetitive and purposive in the sense that improvement or maintenance of one or more components of physical fitness is an objective” (Caspersen et al., 1985; WHO, 2014). Exercise is categorised into two types: non-weight bearing, and weight bearing exercise. Brisk walking, jogging, stationary cycling, water aerobic exercise, swimming, or a myriad of other recreational activities are examples of exercise (Caspersen et al., 1985; WHO, 2014).

### Benefits of exercise during pregnancy

The evidence strongly supports the benefits of regular exercise during pregnancy, which increases physical fitness. Several studies show that exercise is associated with a decrease in the risk of NCDs and obstetrical complications, control of gestational weight gain, reduction in antenatal depression symptoms, reduced rates of macrosomia (a birth weight more than 4,000 grams) and reduced risk of the overweight offspring (Prather et al., 2012; Siebel et al., 2012; Millard et al., 2013; Makinde et al., 2014; Seneviratne et al., 2014).

### Reducing risk of Gestational Diabetes Mellitus (GDM)

Gestational diabetes mellitus (GDM) is associated with several maternal and fetal health problems such as an increasing rate of perinatal morbidity and mortality, the increasing risk of type 2 diabetes mellitus after childbirth and high obstetrics delivery rate (Mudd et al., 2013). Risk of GDM is related to several factors such as overweight, obesity, physical inactivity

or sedentary lifestyle, advanced maternal age, family history of diabetes mellitus and excessive weight gain during pregnancy (Han et al., 2012). An increase in insulin resistance from the placenta during the second trimester of pregnancy (Ouzounian & Elkayam, 2012; Yanamandra & Chandraharan, 2012). may cause gestational diabetes resulting in macrosomia, dystocia in labour, and increasing risk of caesarean section (Han et al., 2012; Ouzounian & Elkayam, 2012; Yanamandra & Chandraharan, 2012). Exercise enhances insulin sensitivity and improves glycogen storage in muscle and liver that would help reduce insulin resistance (Horak & Osman, 2012; Barakat et al., 2014). Moreover, exercise during pregnancy prevents gestational diabetes from both normal BMI and over (Artal et al., 2003; The Royal College of Obstetricians and Gynaecologists, 2006). In addition, recreational moderate and vigorous PA (MVPA) before and during pregnancy can reduce the risk of developing GDM in women with normal pre-pregnancy BMI.

### Weight management

O&O impact on pregnant women through several complications such as pre-eclampsia, hypertensive disorder, impaired glucose tolerance, gestational diabetes mellitus, infection, dystocia in labour and the increasing rate of caesarean section (C/S) including perinatal death, congenital anomalies and macrosomia (Furber et al., 2013; Muktabhant et al., 2012). The recommendation for gestational weight gain between international and Asian criteria is displayed in Table 1. The new guidelines of IOM based on the cut-off points for the BMI categories of WHO and included the new evidence of specific relatively narrow range of recommendation for weight gain for obese women (Rasmussen & Yaktine, 2010; The American College of Obstetricians and Gynecologists, 2013). The new IOM guideline focuses on both total weight gain and rate of weight gain week by week, recommended for implementation in several countries. In Thailand, the national guidelines are drawn from IOM and the cut-off points of overweight and obesity in adults whereas some other studies are based on Asian criteria (Isaranurug et al., 2007; Saereporncharenkul, 2011; Seneviratne et al., 2014). This very much depends on how those researchers considered advantages/disadvantages, including their research objectives, questions and assumptions.

**Table 1.** Recommendation range of weight gain during pregnancy

Pre-pregnancy BMI (kg/m <sup>2</sup> )		Recommendation range of total weight (Kilograms (kg))	Rates of weight gain in second and third trimester (kg/week)
International criteria	Asian Criteria		
BMI < 18.5	BMI < 18.5	12.5-18.0	0.51 (0.44-0.58)
BMI 18.5-24.9	BMI 18.5-22.9	11.5-16.0	0.42 (0.35-0.50)
BMI 25.0-29.9	BMI 23.0-29.9	7.0-11.5	0.28 (0.23-0.33)
BMI > 30	BMI > 30	5.0-9.0	0.22 (0.17-0.27)

(Adapted from: [\(The Institute of Medicine \(IOM\) \(US\) and National Research Council, 2009](#) and [The American College of Obstetricians and Gynecologists, 2013](#)).

Regular exercise such as walking, cycling, and resistance training assist in efficiently controlling standards of maternal gestational weight gain based on pre-pregnancy BMI ([Sui et al., 2012](#)). It prevents and reduces excessive weight gain in O&O women from the baseline pre-pregnancy weight ([Makinde et al., 2014](#); [Sunsaneevithayakul et al., 2014](#)). This is because adipose tissue or fat is converted to muscle and energy ([Barakat et al., 2014](#)). Some studies found that moderate intensity exercise assisted women to control gestational weight gain in both healthy, underweight, and overweight pregnant women ([Brown & Avery, 2012](#); [Jones et al., 2010](#)), including women who had excessive gestational weight gain during pregnancy ([Mudd et al., 2013](#)). As reported in a cohort study of urban Chinese pregnant women, sedentary women had higher average gestational weight gain than active ones during the second and third trimesters ([Jiang et al., 2012](#)). Moreover, some studies confirmed that a combination of intervention between nutrition and exercise programmes increases the success management rate of excessive weight gain in obese pregnant women ([Martin et al., 2014](#)).

### Reducing risk of hypertensive disorders

Hypertensive disorders during pregnancy such as pre-eclampsia, chronic and gestational hypertension are associated with several maternal complications such as eclampsia, coronary heart disease, acute renal failure, gestational diabetes, abruption placenta, and intrauterine growth restriction (IUGR). This also results in offspring complications such as preterm birth, birth asphyxia and respiratory distress syndrome. Exercise reduces blood pressure, levels of stress, and anxiety that

may cause gestational hypertension and pre-eclampsia ([Horak & Osman, 2012](#)).

The mechanism of regular exercise during pregnancy decreases arterial stiffness that leads to cardiovascular disorders such as pregnancy-induced hypertension and myocardial ischemia in low risk pregnant women ([Kawabata et al., 2012](#)). In addition, the effect of 12 week of aerobic exercise training on women with a history of pre-eclampsia included a decrease in blood pressure and the lower risk of cardiovascular diseases, as recorded from arterial pressure and biochemical parameters such as cholesterol, triglycerides and fasting blood glucose. This case control study was conducted with 24 women who had previous pre-eclampsia history and 20 control women of similar characteristics ([Scholten et al., 2014](#)). With some limitations, the participants received a follow-up evaluation of 6-12 months after delivery. The recovery period of pre-eclampsia was within 6 months ([Mikami et al., 2014](#)). Hence, the levels of blood pressure and risk of cardiovascular diseases in women may return to normal within the recovery period after delivery.

### Improvement in musculoskeletal fitness

Pregnant women experience abdominal wall stretch because their enlarged uterus reduces the strength of abdominal wall. The enlarged abdomen shifts the balance of the body (forward) with more lordosis, causing back/low back pain ([Yanamandra & Chandrahara, 2012](#)). Ligament and fascia around the pelvic frame have more flexion because the progesterone hormone generates the alteration of pelvic joint and bone, which can be easily injured. Exercise can increase or maintain physical strength, body balance, and good posture.

PA during pregnancy improves physical fitness, body balance, and posture as well as maintains physical and muscular strength, including increasing lean muscle mass and bone density (Prather et al., 2012). Moreover, some studies confirmed that physical inactivity and/or sedentary lifestyle during pregnancy leads to loss of muscular and cardiovascular fitness and increases incidence and severity of back/low back pain (The Royal College of Obstetricians and Gynaecologists, 2006).

Pregnant women exercising at least three times a week have been found with less low back pain, pelvic girdle pain and leg pain than pregnant women who exercised less than three times a week at third trimester (thirty-two weeks of gestational age) (Field, 2011; Gjestland et al., 2012). The prevalence and intensity of low back pain and pelvic girdle pain has been found to be reduced by exercise, including moderate intensity aerobic exercises and different types of exercises such as tread (Millard et al., 2013), brisk walking, stationary cycling, swimming and water-gymnastics (Kader & Naim-Shuchana, 2014). Aquatic activity offers many benefits during pregnancy because water lessens pressure on joints for pregnant women. Water thus helps reduce pressure on the uterus and pelvis, which improves joint flexibility during pregnancy (Stan, 2014).

### Reducing discomfort during pregnancy

Physiological and psychological alteration during pregnancy impacts on pregnant women, especially discomfort such as nausea, headache, morning sickness, fatigue, constipation, varicose veins and swollen extremities (Yanamandra & Chandharan, 2012). Some studies have demonstrated that PA and/or exercise reduce these common discomforts during pregnancy (Stan, 2014; Fieril et al., 2014; Tiran, 2014) as reflected in increased QoL and wellness scores (Prather et al., 2012). Furthermore, exercise tends to decrease severity of nausea and fatigue symptoms as a result of physical, psychological and social changes during pregnancy (Tiran, 2014). Exercise and dietary interventions during pregnancy have been found to prevent and reduce constipation symptoms during pregnancy and the postpartum period including decreasing the risk of haemorrhoids during pregnancy (Avsar & Keskin, 2010).

### Labour outcomes

Pregnant women engaged in exercise were found to better manage pain during labour process, and experience reduced pain during first and second stages of labour, including a decreased risk of childbirth complications and a higher rate of vaginal birth (Barakat et al., 2014; Kader & Naim-Shuchana, 2014). Studies on PA during pregnancy have supported the reduced incidence of caesarean section, which often occurs with both sedentary and inactive pregnant women (Melzer et al., 2010). Some studies found that exercise and yoga programmes help reduce the perception of labour pain and increase the tolerance of such a pain (Field, 2011; Horak & Osman, 2012). Moreover, a study advocates that moderate intensity of exercise during pregnancy reduces the risk of preterm delivery with pre-pregnancy BMI at least 24 kg/m<sup>2</sup> and over (Guendelman et al., 2013). This cut-off BMI is associated with nearly overweight and over. In other words, moderate exercise could prevent preterm birth in O&O pregnant women.

### Long-term outcomes

Long-term benefits of exercise include protection against the effects of coronary heart disease, and the reduced risk for osteoporosis, diabetes mellitus and hypertension (Hay-Smith, 2013; Horak & Osman, 2012). Clapp III (2008) studied long-term outcomes of women who regularly exercised during pregnancy by comparing the outcomes in two groups: women who had regularly exercised before pregnancy until one year after delivery, and those who had stopped exercise before twelve weeks of gestation until delivery. The study found that pregnant women who participated in a weight-bearing exercise programme during pregnancy and six months after delivery were found with lower risk of cardiovascular diseases, when measured at 18-20 years after the index pregnancy (Clapp III, 2008).

### Psychological aspects

Regular PA and exercise in pregnant women enhances self-esteem, improves body image, self-confidence, sense of control and psychological well-being while reducing stress, anxiety, depression and insomnia symptoms (Fieril et al., 2014; Prather et al., 2012). It also improves stress response and relaxation. Yoga enhances vagal activity with numerous hormonal and physiological

impacts (e.g. reducing cortisol and substance P and increasing serotonin) that reduce blood pressure and heart rate. Pregnant women who engaged in PA had lower scores on anxiety and depression symptoms compared to those who did not perform significant PA (Horak & Osman, 2012). In addition, some studies indicate that taking part in an exercise programme during pregnancy can boost emotional states such as vigour, energy level, enjoyment and euphoria, reducing negative affective states such as anger, tension, confusion, fatigue and depression (Guskowska, Sempolska, et al., 2013).

### Social aspects

Pregnant women engaged in exercise programmes may have more opportunities to meet new people, friends, and families (Gaston et al., 2012), which might lead to networking and collaboration between groups of pregnant women. Some studies found that exercising pregnant women developed closer relationships with families as well as social relationships compared to inactive pregnant women because the former received supportive influences from social models such as family members, friends, and colleagues (Connolly et al., 2014), this also may indirectly reduce stress, anxiety, and depression during pregnancy.

### Life course of offspring outcomes

PA has a significant role in improving the viability of the placenta and placental functional capacity, increasing amniotic fluid level and endothelium dependent vasodilation. These results prevent fetal distress and the risk of pre-eclampsia (Prather et al., 2012), and improve overall fetal growth. Regular moderate intensity exercise during pregnancy is found to produce appropriate birth weight (Doustan et al., 2012), especially for infants born from overweight and obese mothers (Prather et al., 2012; Seneviratne et al., 2014). Some studies indicate that neonates born from exercising mothers had lower birth weight (> 2,500 grams) than those of non-exercising, overweight, obese and gestational diabetes mothers (Tomić et al., 2013). Exercise during pregnancy reduces the rate of macrosomia because mechanisms of PA affect insulin sensitivity, adipose tissue, endocrine regulation and muscle mass (Siebel et al., 2012).

Research on long-term effects of exercise during pregnancy suggests that maternal exercise reduces the risk of developing later

overweight, obesity and cardio-metabolic complications on the next generation (Siebel et al., 2012). Moreover, some studies have reported that offspring of exercising mothers have improved neurodevelopmental outcomes at five years old than those of non-exercising mothers (Prather et al., 2012; Siebel et al., 2012). A cohort study about PA during pregnancy and offspring's cardiovascular risk factors has confirmed that maternal PA during pregnancy is associated with lower BMI, waist circumference, glucose and insulin of offspring at fifteen years old, including an increase in PA at fourteen years old, when compared to those born of inactive mothers, (Millard et al., 2013).

### Prescription of exercise during pregnancy

In Thailand, recommendations of exercise during pregnancy follow the ACOG guidelines endorsed by empirical evidence appropriate in the Thai context (Suputtitada, 2015). For the promotion of mother and child health (The National Economic and Social Development Board, 2011; The National Health Development Plan Committee (NHDPC), 2011). The Department of Health, Thailand developed the implementation of an action plan for all antenatal care units about promoting exercise during pregnancy, The Physical Power for Health Division adapted steps and types of exercise which are suitable in the Thai context (Suputtitada, 2015). Women in low risk pregnancy should perform at least 30 minutes of moderate exercise at least three times a week and progress up to a maximum of five times a week (3rd Regional Health Centre, Nakhon Sawan, 2011; Suputtitada, 2015). Pregnant women who are starting exercise or suffering morning sickness in the first trimester should begin moderate exercise from a minimum of 10 minutes three times a week and progress up to a maximum of approximately 30 minutes per session four times a week (Davies et al., 2003; The Royal College of Obstetricians and Gynaecologists, 2006; The American College of Sports Medicine, 2014). The intensity should be a moderate level of exercise as measured by multiple methods. Firstly, The Royal College of Obstetricians and Gynaecologists (2006), recommends the talk test, whereby the exercising pregnant woman should be able to communicate (in light conversation) during exercise. This is considered to constitute moderate-level exercise. This method is the

simplest measurement of intensity of exercise that pregnant women of all backgrounds can easily remember and apply in their exercise regimens. Secondly, the Borg rating scale is used to measure perceived exertion during exercise. The guidelines recommend twelve to fourteen perceived exertions for moderate exercise (this is generally regarded as somewhat hard). During the exercise activity, the number that best describes the level of perceived exertion on the Borg rating scale is chosen based on the question "how hard you feel like your body is working?" (Nascimento et al., 2015; Evenson et al., 2014). Midwives must clearly explain the meaning of the scale and measurement process for perceived exertion.

Thirdly, moderate intensity of exercise is an energy requirement of three to six metabolic equivalent tasks (METs) (Zavorsky & Longo, 2011). The METs depend on such factors as types and duration of exercise, which are quite difficult to calculate in usual care service. Midwives must clearly explain types and time of exercise for pregnant women. Next, the ACSM recommends the target heart rate (THR) based on a range of age and BMI for measuring intensity of exercise (The American College of Sports Medicine, 2014). Moderate intensity for pregnant women should meet 60-90% of maximum heart rate. This method is quite a good measurement because it considers individual factors of pregnant women such as age and BMI. Pregnant women will be able to measure their heart rate either manually or with equipment after education from midwives. Finally, oxygen consumption can be used to measure maximum oxygen uptake. Pregnant women should meet 50-85% of maximum oxygen uptake (Artal et al., 2003; Prather et al., 2012). This method is clearly a difficult application for pregnant women in the real world because it requires expertise and specific equipment.

ACSM recommends that healthcare professionals (HCPs) should screen for contraindications before pregnant women engaged in exercise (Artal et al., 2003) and be aware of any warning signs during exercise such as vaginal bleeding, dizziness and preterm labour. Risks for exercise should be advised such as falls, muscle injuries and accidents (Artal et al., 2003). The Society of Obstetricians and Gynaecologists of Canada (SOGC) and the Canadian Society for Exercise Physiology (CSEP) recommend Physical Activity Readiness Medical Examination for

Pregnancy (PARmed-X for Pregnancy) as a screening tool for exercise during pregnancy (Davies et al., 2003). For high-risk pregnancy including existing medical conditions such as chronic hypertensive disorder, diabetes mellitus, and morbid obesity more detailed information from a physician or midwife is needed before engaging exercise (Artal et al., 2003; Evenson et al., 2014).

Aerobic exercise, both weight-bearing and non-weight bearing, such as walking, running, jogging, stationary cycling, swimming, aquatic activities, low-impact aerobics, prenatal yoga, muscular workouts, and racquet sports are recommended in pregnancy to maintain physical fitness, improve cardiovascular circulation, and decrease risk of NCDs and control gestational weight gain (Stan, 2014). Exercise has been found to be beneficial and safe for both women and their offspring (Nascimento et al., 2012; Prather et al., 2012; Suputtitada, 2015). However, unsafe activities and contact sports should be contraindicated because these exercises increase the risk of falling, abdominal trauma, and injury to connective muscle tissues (Suputtitada, 2015). Exercise in supine position should be avoided during the second trimester of pregnancy in order to hypotension and Valsalva manoeuvre in pregnancy (Nascimento et al., 2012; Evenson et al., 2014; Suputtitada, 2015).

### **Role of nurse for improving exercise behaviour during pregnancy**

The aim of promoting physical activity and exercise behaviour during pregnancy to reduced effects of sedentary behaviour and improving the maternal and newborn health both short and long term (Suputtitada, 2015). Nurses should be take action based on the nursing process as assessment, nursing diagnosis, planning, implementation, and evaluation. Firstly, the subjective and objective data should be collected to assess pregnant women and context for exercise using critical thinking skill including assessment facilitators and barriers to exercise during pregnancy. Next, nurse should be screen contraindications to physical activity and exercise during pregnancy by an individual exercise checklist at antenatal care clinic. If pregnant women have any contraindications and/or warning signs to exercise, they will be referred to physician for further care. Then,

women in low risk pregnancy should perform at least 30 minutes of moderate exercise at least three times a week and progress up to a maximum of five times a week (3rd Regional Health Centre, Nakhon Sawan, 2011; Suputtitada, 2015). Pregnant women who are starting exercise or suffering morning sickness in the first trimester should begin moderate exercise from a minimum of 10 minutes three times a week and progress up to a maximum of approximately 30 minutes per session four times a week (Davies et al., 2003).

Nurse should be start with exercise education session, which consist of benefits of exercise, physiological change during pregnancy and exercise and exercise safety during pregnancy. The exercise training will be under the supervision of the nurse and consultation of the physiotherapist. Pregnant women will be observed closely and any warning signs will be picked up by the nurse. For instant, training exercise session will include a 5 minutes warm up (muscle stretching), 10-15 minutes muscular workout, 10-15 minutes low-impact aerobics (cardiovascular training) and 5 minutes cool down (muscular progressive relaxation). Duration of the muscular workout and cardiovascular training will increase progressively from 10 minutes during first two weeks to 15 minutes by the end of first month. The muscular workout will include dynamic exercises from head to toe. It will start with a set of 10 repetitions per exercise and progress to 2 sets of 10 repetitions. Muscular workouts will involve a total of 20-30 exercises. The muscular workouts may be modified every 2-4 weeks during the intervention period for enhancing motivation depending on pregnant women's satisfaction. After the exercise in each session, pregnant women will be self-reported using carotid pulse check (peak rate and base rate) and take a rest about 15-30 minutes for checking intensity of exercise. Women should be made aware of any warning signs during exercise following the suggestions of nurses based on the ACOG guidelines (Suputtitada, 2015). Lastly, nurses should inspire, facilitate, and empower women to continuous exercise during pregnancy until postpartum period including reduces barriers to exercise based on context of women.

## CONCLUSION

This scoping review was a description of exercise during pregnancy including benefits

of exercise, recommendation of exercise during pregnancy, prescription, and nurses' role to improve exercise in women. Guidelines recommend that low risk pregnant women without any contraindications should conduct moderate exercise of at least 30 minutes of accumulated exercise a day for at least 3 days a week (The American College of Sports Medicine, 2014; The American College of Obstetricians and Gynecologists, 2015). The findings support healthcare professionals especially nurse at antenatal care clinic to provide appropriate informational support about exercise during pregnancy. Nurse is a key person to improve exercise behaviour continuously in pregnant women as healthy pregnant women that supports them to exercise during pregnancy until postpartum period to decrease risks for NCD.

## Declaration of Interest

None

## Acknowledgment

The authors would like to thank Professor Dr.Kenda Crozier, University of East Anglia, United Kingdom (UK) for her kind support and useful guidance. We also thank our colleges for their kind supports and helpful suggestions.

## Funding

None

## Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

## REFERENCES

- 3rd Regional Health Centre, Nakhon Sawan, T. (2011). *Perinatal care handbook for health professional provider* (D. of Health & M. of P. Health (eds.)). The Health Promoting Hospital.
- Arksey, H., & O'Malley, L. (2005). Scoping studies: towards a methodological framework. *International Journal of Social Research Methodology*, 8(1), 19–32.
- Artal, R., Toole, M. ., & White, S. (2003). Guidelines of the American College of Obstetrics and Gynecologists for exercise during pregnancy and the postpartum period/commentary. *British*

- Journal of Sports Medicine*, 37(1), 6–12.
- Avsar, A. ., & Keskin, H. . (2010). Haemorrhoids during pregnancy. *Journal of Obstetrics and Gynaecology*, 30(3), 231–237.
- Barakat, R., Perales, M., Bacchi, M., Coteron, J., & Refoyo, I. (2014). A programme of exercise throughout pregnancy. Is it safe to mother and newborn? *American Journal of Health Promotion*, 29(1), 1–8.
- Brown, A., & Avery, A. (2012). Healthy weight management during pregnancy: what advice and information is being provided. *Journal of Human Nutrition and Dietetics*, 25(5), 378–388.
- Caspersen, C. ., Powell, K. ., & Christenson, G. . (1985). Physical activity, Exercise, and Physical fitness: definitions and Distinctions for health-related research. *Public Health Reports*, 100(2), 126–131.
- Clapp III, J. . (2008). Long-term outcome after exercising throughout pregnancy: fitness and cardiovascular risk. *American Journal of Obstetrics and Gynecology (AJOG)*, 199(5), 489.e1-489.e6. <https://doi.org/10.1016/j.ajog.2008.05.006>
- Connolly, C. ., Feltz, D. ., & Pivarnik, J. . (2014). Overcoming barriers to physical activity during pregnancy and the postpartum period: The potential impact of social support. *Kinesiology Review*, 3(2), 135–148.
- Currie, S., Sinclair, M., Murphy, M. ., Madden, E., Dunwoody, L., & Liddle, D. (2013). Reducing the decline in physical activity during pregnancy: A systematic review of behaviour change intervention.
- Davies, G. A. L., Wolfe, L. A., Mottola, M. F., & MacKinnon, C. (2003). Exercise in pregnancy and the postpartum period. *Journal of Obstetrics and Gynaecology Canada (JOGC)*, 25(6), 516–529.
- Davies, G. A., Maxwell, C., McLeod, L., Gagnon, R., Basso, M., Bos, H., & Wilson, K. (2010). SOGC clinical practice guideline No.239, February 2010: Obesity in pregnancy. *Journal of Obstetrics and Gynaecology Canada (JOGC)*, 110(2), 165–173.
- Doustan, M., Seifourian, M., Zarghami, M., & Azmsha, T. (2012). Relationship between physical activity of mothers before and during pregnancy with the newborn health and pregnancy outcome. *Journal of Physical Education and Sport (JPES)*, 12(2), 222–229.
- Engberg, E., Alen, M., Kukkonen-Harjula, K., Peltonen, J. ., Tikkanen, H. ., & Pekkarinen, H. (2012). Life events and change in leisure time physical activity: a systematic review. *Sports Medicine*, 42(5), 433–47. <https://doi.org/10.2165/11597610-000000000-00000>
- Evenson, K. ., Mottola, M. ., Owe, K. ., Rousham, E. ., & Brown, W. . (2014). Summary of international guidelines for physical activity after pregnancy. *Obstetrical & Gynecological Survey*, 69(7), 407–414. <https://doi.org/10.1097/ogx.0000000000000077>
- Field, T. (2011). Yoga clinical research review. *Complementary Therapies in Clinical Practice*, 17(1), 1–8.
- Fieril, K., Olsen, M. ., Glantz, A., & Larsson, M. (2014). Experiences of exercise during pregnancy among women who perform regular resistance training: A qualitative study. *Physical Therapy*, 94(8), 1135–1143.
- Furber, C. ., McGowan, L., Bower, P., Kontopantelis, E., Quenby, S., & Lavender, T. (2013). Antenatal interventions for reducing weight in obese women for improving pregnancy outcome (Review). *The Cochrane Library*, 1.
- Gaston, A., Cramp, A. ., & Prapavessis, H. (2012). Pregnancy-should women put up their feet or lace up their running shoes?: Self-presentation and the exercise stereotype phenomenon during pregnancy. *Journal of Sport and Exercise Psychology*, 34(2), 223–237.
- Gjestland, K., Bo, K., Owe, K. M., & Eberhard-Gran, M. (2012). Do pregnant women follow exercise guidelines Prevalence data among 3482 women, and prediction of low-back pain, pelvic girdle pain and depression. *British Journal of Sports Medicine*, 47(8), 515–520.
- Guendelman, S., Pearl, M., Kosa, J. L., Graham, S., Abrams, B., & Kharrazi, M. (2013). Association between preterm delivery and pre-pregnancy body mass (BMI), exercise and sleep during pregnancy among working women in Southern California. *Maternal and Child Health Journal*, 17(4), 723–731.
- Guszkowska, M., Langwald, M., & Sempolska, K. (2013). Influence of a relaxation session and an exercise class on emotional states in pregnant women.

- Journal of Reproductive and Infant Psychology*, 31(2), 121–133.
- Guszkowska, M., Sempolska, K., Zaremba, A., & Langwald, M. (2013). Exercise or relaxation? which is more effective in improving the emotional state of pregnant women? *Human Movement*, 14(2), 168–174.
- Han, S., Middleton, P., & Crowther, C. . (2012). *Exercise for pregnant women for preventing gestational diabetes mellitus (Review)*. <http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD009021.pub2/pdf>.
- Hay-Smith, E. J. . (2013). Maternity exercise 75 years on: what has changed and what does experimental evidence tell us. *New Zealand Journal of Physiotherapy*, 41(1), 16–19.
- Horak, T. ., & Osman, A. (2012). Exercise in pregnancy. *American Obstetrics and Gynaecology Forum*, 22(4), 13–16.
- Isaranurug, S., Mo-suwan, L., & Choprapawon, C. (2007). A population based cohort study of effect of maternal risk factors on low birth weight in Thailand. *Journal of the Medical Association of Thailand*, 90(12), 2559–2564.
- Jiang, H., Qian, X., Li, M., Lynn, H., Fan, Y., Jiang, H., & He, G. (2012). Can physical activity reduce excessive gestational weight gain? Findings from a Chinese urban pregnant women cohort study. *International Journal of Behavioural Nutrition and Physical Activity*, 9(1), 12–18.
- Jones, J., Housman, J., & McAleese, W. (2010). Exercise, nutrition, and weight management during pregnancy. *American Journal of Health Studies*, 25(3), 120–128.
- Kader, M., & Naim-Shuchana, S. (2014). Physical activity and exercise during pregnancy. *European Journal of Physiotherapy*, 16(1), 2–9.
- Kawabata, I., Nakai, A., Sekiguchi, A., Inoue, Y., & Takeshita, T. (2012). The effect of regular exercise training during pregnancy on postpartum brachial-ankle pulse wave velocity, a measure of arterial stiffness. *Journal of Sports Science and Medicine*, 11(3), 489–494.
- Kawabata, I., Nakai, A., Sekiguchi, A., Inoue, Y., & Takeshita, T. (2013). Comparison between the effect of lumbopelvic belt and home based pelvic stabilizing exercise on pregnant women with pelvic girdle pain; a randomized controlled trial. *Journal of Back and Musculoskeletal Rehabilitation*, 26(2), 133–139.
- Mahmood, T., & Arulkumaran, S. (2013). *Obesity: A ticking time bomb for reproductive health* (1st ed.). Elsevier Inc.
- Makinde, O., Adeyemo, F., & Ogeunde, B. (2014). Perception of pregnant mothers attending antenatal clinic on usefulness of prenatal exercise in Osogbo, Osun state, Nigeria. *Health Science Journal*, 8(2), 229–239.
- Marchi, J., Berg, M., Dencker, A., Olander, E. ., & Begley, C. (2015). Risk associated with obesity in pregnancy, for the mother and baby: a systematic review of reviews. *Obesity Reviews*, 16, 621–638. <https://doi.org/10.1111/obr.12288>
- Martin, J. S., Duxbury, A. M. ., & Soltani, H. (2014). An overview of evidence on diet and physical activity based interventions for gestational weight management. *Evidence Based Midwifery*, 12(2), 40–45.
- Melzer, K., Schutz, Y., Boulvain, M., & Kayser, B. (2010). Physical activity and Pregnancy. *Sports Medicine*, 40(6), 493–507.
- Mikami, Y., Takagi, K., Itaya, Y., Ono, Y., Matsumura, H., Takai, Y., & Seki, H. (2014). Post-partum recovery course in patients with gestational hypertension and pre-eclampsia. *The Journal of Obstetrics and Gynaecology Research*, 40(4), 919–925. <https://doi.org/10.1111/jog.12280>
- Millard, L. A. ., Lawlor, D. ., Fraser, A., & Hiowe, L. . (2013). Physical activity during pregnancy and off spring cardiovascular risk factors: finding from a prospective cohort study.
- Mudd, L. ., Owe, K. ., Mottola, M. ., & Pivarnik, J. . (2013). Health benefits of physical activity during pregnancy: An international perspective. *Journal of the American College of Sports Medicine*, 45(2), 268–277.
- Muktabhant, B., Lumbiganon, P., Ngamjarus, C., & Dowswell, T. (2012). Interventions for preventing excessive weight gain during pregnancy (Review).
- Nascimento, S. ., Surita, F. ., & Cecatti, J. . (2012). Physical exercise during pregnancy: a systematic review. *Current Opinion in Obstetrics & Gynecology*, 24(6), 387–394.

- Nascimento, S. ., Surita, F. ., Godoy, A. ., Kasawara, K. ., & Morais, S. . (2015). Physical activity patterns and factors related to exercise during pregnancy: a cross sectional study. *PLoS One*, *10*(6). <https://doi.org/10.1371/journal.pone.0128953>
- Ouzounian, J. ., & Elkayam, U. (2012). Physiologic changes during normal pregnancy and delivery. *Cardiology Clinics*, *30*(3), 317–329. <https://doi.org/10.1016/j.ccl.2012.05.004>
- Özdemir, A. (2015). Maternal obesity and public health. *International Journal of Caring Sciences*, *8*(1), 217–220.
- Peters, M. D., Godfrey, C. M., Khalil, H., McInerney, P., Parker, D., & Soares, C. B. (2015). Guidance for conducting systematic scoping reviews. *International Journal of Evidence-Based Healthcare*, *13*(1), 141–146. <https://doi.org/10.1097/XEB.0000000000000050>
- Prather, H., Spitznagle, T., & Hunt, D. (2012). Benefits of exercise during pregnancy. *The American Academy of Physical Medicine and Rehabilitation*, *4*(11), 845–850. <https://doi.org/10.1016/j.pmrj.2012.07.012>
- Rasmussen, K. ., & Yaktine, A. . (2010). *Weight gain during pregnancy: Reexamining the Guidelines*. National Academies Press (US).
- Saereeporncharenkul, K. (2011). Correlation of BMI to pregnancy outcomes in Thai women delivered in Rajavithi Hospital. *Journal of the Medical Association of Thailand*, *94*(2), S52–S58.
- Scholten, R. R., Thijssen, D. ., Lotgering, F. ., Hopman, M. ., & Spaanderman, M. . (2014). Cardiovascular effects of aerobic exercise training in formerly preeclamptic women and healthy parous control subjects. *American Journal of Obstetrics and Gynecology*, *211*(5), 516.e1–516.e11. <https://doi.org/10.1016/j.ajog.2014.04.025>
- Seneviratne, S. N., Parry, G. K., McCowan, L. M., Ekeroma, A., Jiang, Y., Gusso, S., Peres, G., Rodrigues, R. O., Craigie, S., Cutfield, W. S., & Hofman, P. L. (2014). Antenatal exercise in overweight and obese women and its effects on offspring and maternal health: design and rationale of the IMPROVE (Improving Maternal and Progeny Obesity via Exercise) randomised controlled trial. *BMC Pregnancy and Childbirth*, *14*(1), 1–16. <https://doi.org/10.1186/1471-2393-14-148>
- Siebel, A. L., Carey, A. L., & Kingwell, B. A. (2012). Can exercise training rescue the adverse cardio-metabolic effects of low birth weight and prematurity? *Clinical and Experimental Pharmacology and Physiology*, *39*(11), 944–957. <https://doi.org/10.1111/j.1440-1681.2012.05732>
- Stan, A. . (2014). Pregnancy and aquatic aerobic activity. *Sport and Society Interdisciplinary Journal of Physical Education and Sport*, *4*(special issue), 260–268.
- Sui, Z., Grivell, R. ., & Dodd, J. . (2012). Antenatal exercise to improve outcomes in overweight or obese women: a systematic review. *Acta Obstetrica et Gynecologica Scandinavica*, *91*(15), 538–545.
- Sunsaneevithayakul, P., Titapant, V., Ruangvutilert, P., Sutantawibul, A., Phatihattakorn, C., Wataganara, T., & Talungchit, P. (2014). Relation between gestational weight gain and pregnancy outcomes. *The Journal of Obstetrics and Gynaecology Research*, *40*(4), 995–1001.
- Suputtitida, A. (2015). *Series of exercise recommendation for healthcare professionals: Guideline of promoting exercise during pregnancy in community healthcare centre*. Division of Physical Activity and Health, Department of Health, Ministry of Public Health (MoPH).
- The American College of Obstetricians and Gynecologists, (ACOG). (2002). Exercise during pregnancy and the postpartum period. *Journal of Gynecology and Obstetrics*, *77*(1), 79–81.
- The American College of Obstetricians and Gynecologists, (ACOG). (2013). *Committee opinion number 548: Weight gain during pregnancy*. <https://www.acog.org/-/media/Committee-Opinions/Committee-on-Obstetric-Practice/co548.pdf?dmc=1>
- The American College of Obstetricians and Gynecologists, (ACOG). (2015). *Committee opinion number 650: Physical activity and exercise during pregnancy and the postpartum period*.
- The American College of Sports Medicine, (ACSM). (2014). *ACSM's Guidelines for exercise testing and prescription* (9th

- ed.). USA: Lippincott Williams & Wilkins.
- The Centers for Disease Control and Prevention, (CDC). (2012). *Adults overweight and obesity*. <http://www.cdc.gov/obesity/adult/causes/>
- The Centers for Disease Control and Prevention, (CDC). (2014). *State Indicator Report on Physical Activity, 2014*.
- The Institute of Medicine (IOM) (US) and National Research Council, I. (2009). *Weight gain during pregnancy: Reexamining the Guidelines* (K. . Rasmussen & A. . Yaktine (eds.)). National Academies Press (US).
- The Ministry of Public Health (MoPH), T. (2019). *Statistics Thailand 2019*. <http://www.hiso.or.th/hiso/picture/reportHealth.pdf>
- The National Economic and Social Development Board, T. (2011). *Summary the Eleventh National Economic and Social Development Plan 2012-2016*. Office of the Prime Minister.
- The National Health Development Plan Committee (NHDPC), T. (2011). *National Health Development Plan in period of the Eleventh National Economic and Social Development Plan 2012-2016*. Department of Health, Ministry of Public Health (MoPH).
- The National Heart Foundation of Australia. (2015). *Level of exercise statistics*.
- The Royal College of Obstetricians and Gynaecologists, (RCOG). (2006). *Exercise in pregnancy*. <https://www.rcog.org.uk/globalassets/documents/patients/patient-information-leaflets/pregnancy/recreational-exercise-and-pregnancy.pdf>
- The World Health Organization (WHO). (2014). *Global health observatory (GHO) data: overweight and obesity*. [http://www.who.int/gho/ncd/risk\\_factors/overweight/en/](http://www.who.int/gho/ncd/risk_factors/overweight/en/)
- The World Health Organization (WHO). (2015). *Non-communicable diseases*. <http://www.who.int/mediacentre/factsheets/fs355/en/>
- Tiran, D. (2014). Nausea and vomiting in pregnancy: An 'alternative' approach to care. *British Journal of Midwifery*, 22(8), 544–550.
- Tomić, V., Sporiš, G., Tomić, J., Milanović, Z., Zigmundovac-Klaić, D., & Pantelić, S. (2013). *The effect of maternal exercise during pregnancy on abnormal fetal growth*.
- Yanamandra, N., & Chandraharan, E. (2012). *Anatomical and physiological changes in pregnancy and their implications in clinical practice*. [http://assets.cambridge.org/97805212/68271/excerpt/9780521268271\\_excerpt.pdf](http://assets.cambridge.org/97805212/68271/excerpt/9780521268271_excerpt.pdf).
- Zavorsky, G. ., & Longo, L. . (2011). Exercise guidelines in pregnancy. *Sports Medicine*, 41(5), 345–360.
- Zhang, Y., Dong, S., Zuo, J., Hu, X., Zhang, H., & Zhao, Y. (2014). Physical activity level of urban pregnant women in Tianjin, China: a cross-sectional study. *PLoS One*, 9(10), e109624. <https://doi.org/10.1371/journal.pone.0109624>