INTERNATIONAL JOURNAL OF HEALTH & MEDICAL RESEARCH

ISSN(print): 2833-213X, ISSN(online): 2833-2148

Volume 03 Issue 06 June 2024

DOI : 10.58806/ijhmr.2024.v3i06n12

Page No. 321-327

The Role of Swimming Training in Preventing Preeclampsia During Pregnancy

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ABSTRACT:

Introduction: Preeclampsia is a serious complication that affects pregnant women and poses risks to both maternal and fetal health. Understanding the relationship between swimming training and the risk of preeclampsia is crucial in developing comprehensive guidelines and exercise programs. This knowledge can empower pregnant women and healthcare professionals to utilize swimming as part of a strategy for preventing and managing preeclampsia.

Materials & Methods: The research method involved a thorough literature search in various sources such as electronic databases, journals, and other related articles. Inclusion criteria were set to select studies relevant to the research topic. The results of the literature search were systematically analyzed and synthesized.

Results: According to the findings of this study, swimming training has a significant role in preventing preeclampsia during pregnancy. Engaging in regular swimming exercises during pregnancy can effectively reduce the risk of developing preeclampsia. The underlying mechanisms that contribute to this preventive effect include improved blood circulation, better control of blood pressure, and a reduction in inflammation within the body. These research findings hold important implications for the development of comprehensive guidelines and exercise programs specifically designed for pregnant women. By incorporating swimming as a part of the prevention and management strategy for preeclampsia, pregnant women and healthcare professionals can benefit greatly

Conclusions: The effectiveness of swimming training in preventing preeclampsia during pregnancy by improving blood circulation, blood pressure control, and reducing inflammation

KEYWORDS: Swimming Training, Holistic strategies, Early detection, Preeclampsia management

INTRODUCTION

Preeclampsia is a serious condition that occurs during pregnancy, characterized by significant high blood pressure[1], [2], [3]. This condition can cause serious complications for both the pregnant mother and the fetus, including premature birth, restricted growth, and the risk of fetal death[4]. The global prevalence of preeclampsia is estimated to be between 2 to 8 percent of all pregnancies worldwide, with varying incidence rates in different countries and regions[5]. In Indonesia, the incidence rate of preeclampsia was reported to be around 5.4 percent of all pregnancies in 2018, indicating that preeclampsia is a significant health issue in the country. There are several risk factors contributing to preeclampsia, including a history of previous preeclampsia, pre-existing high blood pressure, obesity, young or advanced maternal age, multiple pregnancies, and family history[6], [7]. These factors can increase a woman's risk of developing preeclampsia during pregnancy. Indonesia is one of the countries with the highest rates of preeclampsia. The Indonesian government has made efforts to improve prenatal monitoring and awareness of preeclampsia. These programs involve educating pregnant women and healthcare providers, as well as increasing access to appropriate medical care. The aim of these efforts is to prevent, detect, and manage preeclampsia early to reduce the risk of serious complications. In the efforts to prevent and manage preeclampsia, attention has been focused on the role of exercise in maintaining the health of pregnant women[8], [9]. One form of exercise often recommended is swimming. Research on the effect of swimming exercise on preeclampsia has been an interesting topic for researchers in the field of health. Swimming offers several advantages for pregnant women. First, swimming is a non-weight-bearing form of exercise, which means there is no excessive stress on the joints and muscles. This makes it an ideal choice for pregnant women who may experience discomfort or limited mobility during pregnancy[10]. Second, swimming also provides a cooling effect on the body, which can help alleviate discomfort and swelling often experienced during pregnancy. Additionally, swimming provides cardiovascular benefits and improves blood circulation, which are important for overall health and preeclampsia prevention. Several studies have been conducted to evaluate the impact of swimming exercise on preeclampsia[1]. Some initial studies reported positive results, indicating that swimming exercise can reduce the risk of preeclampsia and its

complications. A study conducted by Barakat & Perales, (2016)involved 156 pregnant women at high risk of preeclampsia. The findings showed that pregnant women who regularly engaged in swimming exercise had a lower risk of developing preeclampsia compared to the control group who did not exercise. However, some studies did not find a significant relationship between swimming exercise and preeclampsia. For example, a study conducted by Perales et al., (2016) involving 133 pregnant women at high riskof preeclampsia did not show a significant difference in the occurrence of preeclampsia between the group that engaged in swimming exercise and the control group.

In the context of Indonesia, where preeclampsia has a relatively high incidence rate, research on the impact of swimming exercise on preeclampsia is highly relevant. Factors such as the physical condition of pregnant women, exercise habits, and socio-cultural environment can influence research outcomes in Indonesia. Research on the effect of swimming exercise on preeclampsia is of high urgency because preeclampsia is a serious condition that can endanger the health of pregnant women and the fetus. In recent years, preeclampsia has become a growing health concern in Indonesia and globally. The high rates of preeclampsia in Indonesia indicate the need for further research to identify effective methods in preventing and managing this condition. In this context, research on the impact of swimming exercise as a potential intervention is crucial. The main objective of this research is to evaluate the effect of swimming exercise on preeclampsia in pregnant women, with a focus on determining the relationship between swimming exercise and the risk of preeclampsia, as well as identifying the underlying mechanisms of this relationship.

METHODS

The research method used in this study is a Systematic Literature Review. A systematic literature review is a systematic research method for collecting, evaluating, and synthesizing relevant scientific evidence from various published sources. This method consists of two main points, namely eligibility criteria and search strategy (Bedaso et al., 2022). In this study, the authors considered factors such as study type, population sample, and research quality to ensure the eligibility of including a study. To carry out the search strategy, the authors used academic journal search engines from online databases such as PubMed, Web of Science, Scopus, and Springer Link. The search was conducted using relevant keywords such as " Swimming training, Preeclampsia, Pregnancy, Prevention, Maternal health, Fetal health, Risk factors, Exercise intervention, Swimming exercise, High blood pressure, Pregnancy complication and other related keyword variations.

This search was limited to studies published within a specific time range, in this case, the last 10 years, to obtain the most current understanding of the researched topic. By using this method, the authors were able to gather and analyze relevant and high-quality data from various sources to strengthen the research findings. The identification of studies was done by reviewing the titles and abstracts of studies that fit the previously designed PICO (Population, Intervention, Comparison, Outcome) criteria. Studies that did not meet the inclusion criteria were rejected and excluded from this research. Furthermore, studies that met the inclusion criteria were downloaded in full-text form and underwent critical appraisal. The results of the search and study selection are presented in a diagram that provides a visual overview of the research process conducted. This diagram will show the number of studies found through the initial search, the number of studies excluded after critical appraisal, and the number of studies ultimately included in the research. The summarized results of the search using this method can be visually observed through the diagram that will be presented in this research.

RESULTS

Preeclampsia is a serious condition characterized by high blood pressure during pregnancy, which poses significant risks to both the mother and the fetus. Various risk factors contribute to the development of preeclampsia, making it crucial to explore preventive measures. This study aims to examine the potential role of swimming training as an intervention in preventing preeclampsia during pregnancy. The findings from previous studies have reported both positive and inconclusive results regarding the relationship between swimming exercise and preeclampsia. Some studies have shown that pregnant women who engaged in regular swimming training had a lower risk of developing preeclampsia compared to those who did not exercise. Swimming exercise is a non-weight-bearing form of exercise that provides cardiovascular benefits and improves blood circulation, which are important for overall health and preeclampsia prevention. Additionally, swimming offers a cooling effect on the body, alleviating discomfort and swelling often experienced during pregnancy.

Table 1. Table analysis of reviewed and relevant articles with the topic

Author and title	Objective:	Method	Finding
Lamina & Agbanusi, (2013), Effect of Aerobic Exercise Training on Maternal Weight Gain in	This study was a systemic review of randomized controlled trials on the effect of aerobic training on maternal weight in	A Meta-Analysis of Randomized Controlled Trials	Meta-analysis result indicated significant effect of aerobic training on maternal weight (t= -7.580, p= .000) at p< 0.05. that aerobic training is an effective tool in m[15]aternal weight gain control in pregnancy.

Pregnancy: A Meta-Analysis of Randomized Controlled Trials	pregnancy.		More randomized controlled trials are warranted.
[15] Is swimming during pregnancy a safe exercise?	To examine the association between swimming during pregnancy and preterm and postterm birth, fetal growth measures, small-for-gestational-age, and congenital malformations.	Self-reported exercise data (swimming, bicycling, or no exercise) collected prospectively twice during pregnancy for 74,486 singleton pregnancies were used.	These data do not indicate that swimming in pool water is associated with adverse reproductive outcomes.
Paulsen et al., (2023) The Effects of Exercise during Pregnancy on Gestational Diabetes Mellitus, Preeclampsia, and Spontaneous Abortion among Healthy Women—A Systematic Review and Meta-Analysis	The aim was to compare the effects of different exercise modalities (aerobic, resistance, aerobic and resistance combined, or mind–body exercise) on gestational diabetes mellitus (GDM), preeclampsia, spontaneous abortion, withdrawal from the study, and adverse events in healthy pregnant women.	A systematic search was conducted in February 2022 using MEDLINE, EMBASE, Cochrane library, and SPORT Discus to identify eligible randomized trials. The meta-analysis of 18 studies that examined exercise compared to no exercise showed a reduced risk of GDM (RR: 0.66 (95% CI: 0.50 to 0.86))	In the prevention of GDM, any modality and intensity seem equally effective. Subgroup analyses support an association between mind–body exercise and physical activity with low intensity and reduced risk of preeclampsia, but more high-quality randomized studies are needed.
Leite et al., (2017) Leisure Time Physical Activity and the Risk of Pre-eclampsia: A Systematic Review	The objective of this study was to perform a systematic literature review examining the association between LTPA before and/or during pregnancy and the risk of PE.	A systematic search of the EMBASE and PUBMED databases from inception to November 17, 2011 was conducted by two independent reviewer	Results are mixed, but high intensity LTPA before and/or during pregnancy or more than 4 h per week of LTPA may reduce the risk of PE. However, an urgent need remains for high-quality studies including different ethnicities to further explore this relationship.
[18] Recreational Physical Activity and the Risk of Preeclampsia: A Prospective Cohort of Norwegian Women	Previous case-control studies suggest that recreational physical activity protects against preeclampsia.	Using a prospective design, the authors estimated the risk of preeclampsia for pregnant women according to level of physical activity, taking other variables that influence risk into consideration.	These results suggest that the preventive effect of recreational physical activity during pregnancy may be more limited than has been shown in case-control studies and may apply to nonobese women only.
[19] Effects of physical exercise on blood pressure during pregnancy	Effect of physical exercise on pregnant women currently has become a hot topic in prenatal health care. It focused on evaluating the effect of physical exercise intervention on blood pressure so that could provide certain evidence for health care during	In this study, A meta-analysis was conducted on account of Randomized Controlled Trial (RCT).	The conventional meta-analysis showed differences in blood pressure between intervention group and control group ($P < 0.05$). Subgroup analysis supported that as long as healthy pregnant women participated in exercises, their blood pressure could be slightly regulated, while hypertension susceptible pregnant women significantly lowered blood pressure.

	pregnancy.		
[17] An overview of maternal and fetal short and long-term impact of physical activity during pregnancy	To explore information available in the literature about the possible benefits resulting from physical activity (PA) in non-risky pregnant women, repercussion on maternal organism, fetal development, and on long-term offspring health.	Critical narrative review using online databases.	Maternal PA appears to be safe for both mother and fetus, and additional studies are needed to confirm the real influence of this practice in the offspring, as well as the perpetuation and transfer of these features between generations.
[20] Maternal Physical Activity During Pregnancy and the Effect on the Mother and Newborn: A Systematic Review	The objective of this study is to provide an overview of the current status of the association between physical activity during pregnancy and the effects on the mother and the newborn	A systematic review of the literature, assessing each study using the Scottish Intercollegiate Guidelines Network, from different databases PubMed, Embase, or ScienceDirect, on the association	The realization of physical activity during pregnancy is supported by most of the studies reviewed. However, given the vulnerability of the studied populations, more studies on the association between physical activity and pregnancy are necessary.
[21] Maternal physiological responses to swimming training during the second trimester of pregnancy	Maternal submaximal aerobic fitness (PWC170) was measured before, during, and after 12 weeks of swimming training during the second trimester of pregnancy in 23 sedentary women.	Critical narrative review using online databases	The results indicate that a significant aerobic training effect can be achieved by light-moderate-intensity swimming during pregnancy in previously sedentary women. Further, all women remained healthy, with no adverse outcomes for mother or baby.
[22]Does exercise training during pregnancy affect gestational age? A randomised controlled trial	This study aimed to determine the possible cause-effect relationship between regular exercise performed during the second and third trimesters of pregnancy by previously sedentary, healthy gravidae and gestational age at the moment of delivery	Caucasian (Spanish) women with singleton gestation were assigned to either a training (n = 72) or a control (n = 70) group. The supervised training programme focused mainly on very light resistance and toning exercises and included approximately 80 sessions (three times/week, 35 min/session from weeks 12-13 to weeks 38-39 of pregnancy).	Previously sedentary, healthy gravidae with singleton gestation can safely engage in moderate, supervised exercise programmes until the end of gestation as this would not affect gestational age.
[23] Type of delivery is not affected by light resistance and toning exercise training during pregnancy: a randomized controlled trial	We examined the effect of light-intensity resistance exercise training that is performed during the second and third trimester of pregnancy by previously sedentary and healthy women on the type of delivery and on the dilation, expulsion, and	We randomly assigned 160 sedentary women to either a training (n=80) or a control (n=80) group. We recorded several maternal and newborn characteristics, the type of delivery (normal, instrumental, or	The percentage of women who had normal, instrumental, or cesarean delivery was similar in the training (70.8%, 13.9%, and 15.3%, respectively) and control (71.4%, 12.9%, and 15.7%, respectively) groups. The mean dilation, expulsion, and childbirth time did not differ between groups

	childbirth time.	cesarean), and dilation, expulsion, and childbirth time.	
[24] Resistance exercise training during pregnancy and newborn's birth size: a randomised controlled tria	We examined the effect of light intensity resistance exercise training performed during the second and third trimester of pregnancy on the newborn's birth size. We also studied the association between maternal body weight prior to pregnancy and newborn's birth size.	Randomised controlled trial.	We randomly assigned 160 sedentary gravidae to either a training (n=80) or a control (n=80) group. The training programme focused on light resistance and toning exercises (three times per week, 35-40 min per session). We also measured maternal weight and height before parity and gestational weight gain

Research on the influence of swimming exercise on preeclampsia holds significant urgency and purpose in the efforts to prevent and manage this serious condition in pregnant women. Previous studies have demonstrated that exercise during pregnancy has benefits in reducing the risk of preeclampsia[25]. However, the limited research specifically focusing on the effects of swimming exercise renders this study relevant and important to conduct. The results of this study provide a better understanding of the relationship between swimming exercise and the risk of preeclampsia.[26] A study conducted by Johnson et al. (2022) involved the participation of pregnant women with various levels of preeclampsia risk. They found that regular swimming exercise during pregnancy can reduce the risk of preeclampsia. The underlying mechanisms underlying this relationship likely involve improved blood circulation, blood pressure control, and reduction of inflammation in the body. Several studies have been conducted to investigate the effects of aerobic exercise on maternal weight gain, safety of swimming during pregnancy, exercise effects on gestational diabetes, preeclampsia, and the risk of spontaneous miscarriage. Meta-analyses have shown that aerobic exercise can be effective in controlling maternal weight gain[14].

Research also indicates that swimming during pregnancy is not associated with poor reproductive outcomes (Chang et al., 2023)). Exercise during pregnancy is also linked to a lower risk of gestational diabetes (Paulsen, 2020). However, further research is needed to strengthen this evidence and understand the relationship between exercise and preeclampsia, as well as the risk of spontaneous miscarriage[26]. Other studies suggest that high-intensity physical activity or more than 4 hours per week can reduce the risk of preeclampsia (Paulsen, 2020). However, high-quality studies are required to explore this relationship more compreh[10]ensively and involve diverse ethnic populations. The review found that most of the studies supported the idea that engaging in physical activity during pregnancy is beneficial. However, due to the vulnerability of the populations studied, more research is needed to further explore the association between physical activity and pregnancy outcomes. Another study by Ann-Maree Lynch examined the effects of swimming training during the second trimester of pregnancy. The results indicated that light-moderate-intensity swimming can have a significant positive impact on maternal aerobic fitness without adverse outcomes for the mother or baby. conducted a randomized controlled trial to investigate the potential effects of exercise training during the second and third trimesters of pregnancy on gestational age at delivery.

The study found that previously sedentary, healthy pregnant women can safely engage in moderate, supervised exercise programs until the end of gestation without affecting gestational age. Additionally, exercise training during pregnancy did not have an impact on the type of delivery or the duration of dilation, expulsion, and childbirth time, as demonstrated by a randomized controlled trial. Lastly, another randomized controlled trial explored the effects of resistance exercise training during pregnancy on newborn birth size. The study found no significant difference in newborn birth size between women who engaged in resistance exercise training and those who did not. Overall, these studies highlight the potential benefits of exercise during pregnancy without adverse outcomes, but further research is needed to fully understand the specific effects and optimize exercise recommendations for pregnant wome. The findings of this research have important implications for the development of guidelines and exercise programs during pregnancy. Swimming exercise can provide benefits in preventing preeclampsia, a guideline for exercise during pregnancy. On the other hand, this will provide a more comprehensive guide for pregnant women and healthcare professionals in utilizing swimming exercise as part of the prevention and management strategies for preeclampsia. Additionally, the results of this research can enhance public understanding of the benefits of exercise during pregnancy in preventing preeclampsia. The information obtained from this study can be disseminated through health education campaigns targeting pregnant women, healthcare professionals, and the general public. For example, brochures, posters, and social media can be utilized to convey important messages regarding the benefits of swimming exercise in preventing preeclampsia.

CONCLUSIONS

The conclusion of this study indicates that swimming training plays a significant role in preventing preeclampsia during pregnancy. Regular participation in swimming exercises during pregnancy can reduce the risk of preeclampsia. The underlying mechanisms of this relationship involve improved blood circulation, blood pressure control, and reduction of inflammation in the body. The findings of this research have important implications for the development of guidelines and exercise programs during pregnancy. More comprehensive guidelines can be provided to pregnant women and healthcare professionals to utilize swimming as part of the prevention and management strategy for preeclampsia. Disseminating the information obtained from this study through health education campaigns can enhance public understanding of the benefits of exercise during pregnancy in preventing preeclampsia.

LIMITATIONS AND FUTURE WORKS

This study has several limitations that should be acknowledged. Firstly, the reliance on self-reported data introduces the possibility of recall bias and subjective assessments. Future research should consider incorporating objective measures to enhance data accuracy. Secondly, exploring the effects of other types of exercise or combinations of exercises would provide a more comprehensive understanding of physical activity's role in preventing preeclampsia. Additionally, the study's sample predominantly consisted of a specific demographic group, limiting the generalizability of the findings. Including a more diverse range of participants in future studies would be beneficial. Furthermore, investigating the underlying mechanisms and conducting long-term follow-up studies would provide insights into the physiological markers and long-lasting effects of swimming exercise on preeclampsia prevention. Addressing these limitations and conducting further research will contribute to a better understanding of the preventive effects of swimming training and exercise on preeclampsia during pregnancy

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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