

Prenatal Yoga and the Reduction of Hypertension Risk in Pregnancy: A Narrative Review

Vina Firmanty Mustofa¹, Viska Putri Aulia Firdaus¹, Herdhika Ayu Retno Kusumasari²

¹Midwifery Study Program, Faculty of Medicine, Universitas Negeri Surabaya

²Department of Midwifery, Faculty of Medicine, Universitas Brawijaya Malang

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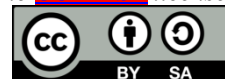
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ABSTRACT

Hypertensive disorders of pregnancy remain a major cause of maternal morbidity and mortality, highlighting the need for safe and accessible non-pharmacological strategies to support cardiovascular stability during pregnancy. Prenatal yoga has gained growing attention as a mind-body intervention that integrates physical postures, breathing techniques, and meditation to enhance both physiological and psychological well-being. This narrative review aims to synthesize and critically discuss current scientific evidence on the role of prenatal yoga in regulating blood pressure and reducing the risk of hypertensive disorders during pregnancy. The literature search was conducted using major electronic databases, including PubMed, ScienceDirect, and Scopus, covering publications from 2020 to 2025. Evidence indicates that prenatal yoga supports autonomic regulation by enhancing parasympathetic activity, improving baroreflex sensitivity, increasing heart rate variability, and reducing excessive sympathetic activation. Yoga also modulates stress-related neuroendocrine pathways by attenuating the hypothalamic-pituitary-adrenal axis activity and lowering circulating stress hormones. In addition, improvements in vascular function have been reported, particularly through increased nitric oxide bioavailability and reduced vasoconstriction and inflammatory activity, contributing to improved hemodynamic stability. Clinical studies consistently demonstrate reductions in systolic and diastolic blood pressure among healthy pregnant women, those at risk of gestational hypertension, and women with mild preeclampsia. These physiological benefits are accompanied by psychological improvements, including reduced stress, anxiety, and depressive symptoms. Overall, the findings support prenatal yoga as a safe, feasible, and effective complementary intervention for improving cardiovascular regulation and reducing hypertension risk during pregnancy, with particular relevance for low-resource settings.

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Corresponding Author:

Vina Firmanty Mustofa

Midwifery Study Program, Faculty of Medicine, Universitas Negeri Surabaya

Email: vinamustofa@unesa.ac.id

1. INTRODUCTION

One of the most prevalent obstetric problems is hypertension during pregnancy (also known as hypertensive disorders of pregnancy, or HDP), which has a major global impact on maternal and perinatal morbidity and mortality (Danielli et al., 2022). About 5–10% of pregnancies worldwide are affected by HDP, and preeclampsia occurs in 2–8% of cases in different parts of the world (Murdiningsih et al., 2023). Due to restricted access to early identification and health care, the incidence rate in poor nations is typically higher than in industrialized nations. The incidence of preeclampsia in pregnant women ranges from 1.3% to 6% in affluent nations and from 1.8% to 18% in poor countries, according to 2018 WHO data. Preeclampsia affected 2.7% of pregnant women in Indonesia, according to Basic Health Research (Riskesdas). According to regional data, East Java Province had a relatively high rate of preeclampsia and eclampsia in 2018, 31% (Fathonah et al., 2024).

Several risk factors have been linked to increasing HDP incidence. Gestational hypertension is caused by decreased cardiovascular regulation and inflammatory reactions, which are exacerbated by psychological stress, sedentary lifestyles, and inactivity (Makhija et al., 2021). In both the general population of pregnant women and those at risk of hypertension, physical activity has been demonstrated to lower blood pressure (Barakat et al., 2024). Physical exercise interventions can lower systolic and diastolic blood pressure in pregnant women by 3.19 mmHg and 2.14 mmHg, respectively, according to a 2022 meta-analysis by Zhu et al. This impact is particularly noticeable in populations at risk for hypertension (Zhu et al., 2022). Barakat et al. (2024) have published similar results, stating that physical activity during pregnancy can considerably lower systolic and diastolic blood pressure and lower the risk of HDP (RR = 0.44) (Barakat et al., 2024).

Hormonal control and efficient stress reduction are essential for preserving hemodynamic stability and normal vascular function throughout pregnancy. Pregnancy-induced hypertension has been strongly associated with changes in hormone balance, increased sympathetic activity, and inflammatory reactions (Bhartia et al., 2019). Reduced baroreflex sensitivity (BRS) and heart rate variability (HRV), two important markers of cardiovascular stability during pregnancy, are linked to oxidative stress and inflammation, which are indicated by increased IL-6 levels and decreased nitric oxide (NO), according to research by Karthiga et al. These results emphasize the significance of therapies that can enhance parasympathetic activity, stabilize neuroendocrine responses, and improve stress control in attempts to prevent hypertensive diseases of pregnancy (Karthiga et al., 2022).

Prenatal yoga has become a popular mind-body technique in maternal health care. Yoga provides concurrent physiological and psychological advantages through the integration of physical movement, controlled breathing, and meditation (Smith et al., 2025). Because it is safe, accessible, and ideal for expectant mothers, its use has expanded over the past ten years (Cramer et al., 2018). Its ability to lessen pregnancy-related problems has been investigated in a number of studies. Significantly, a 20-week yoga program was found to improve cardiometabolic parameters such as HRV, BRS, and NO levels while reducing the incidence of pregnancy hypertension from 38.1% to 6.61% (Karthiga et al., 2022). In Indonesia, a study by Murdiningsih found that women with moderate preeclampsia experienced significant reductions in systolic and diastolic blood pressure after four weeks of prenatal yoga practice (Murdiningsih et al., 2023). Yoga-based therapies have also been demonstrated to be viable and well accepted by women who have a history of pregnancy-related hypertension problems (Smith et al., 2025).

Despite an increasing number of studies reporting positive effects of prenatal yoga, the existing data remain fragmented and inconsistent, particularly in intervention design, duration, and outcome measures (Nalbant et al., 2022). Furthermore, many current reviews have tended to focus on specific outcomes rather than the interplay between the physiological, psychological, and clinical factors driving pregnancy hypertensive problems (Zhu et al., 2022). This narrative review attempts to fill this gap by combining these dimensions into a single framework that connects autonomic regulation, stress-related hormonal changes, endothelial function, inflammatory processes, and blood pressure outcomes.

As a result, the purpose of this narrative review is to integrate scientific evidence regarding the impact of prenatal yoga in preventing or reducing the risk of hypertension during pregnancy. The review discusses physiological causes, psychological aspects of stress management, and clinical data on blood pressure and fetal outcomes. By describing these interrelationships, this study intends to establish a strong scientific basis for integrating the use of prenatal yoga as a complementary strategy for reducing hypertensive diseases of pregnancy, particularly in low-income nations like Indonesia.

2. METHOD

The relevant literature for this narrative review was gathered from a variety of scientific publications, including clinical studies, experimental research, systematic reviews, and physiology-based articles that address blood pressure-regulating systems. The literature search was conducted using major electronic databases, including PubMed, ScienceDirect, and Scopus, with a focus on articles published between 2020 and 2025. The search approach used keyword combinations such as "*prenatal yoga*," "*pregnancy yoga*," "*blood pressure*," "*gestational hypertension*," "*exercise*," "*hypertensive disorders in pregnancy*," "*hypertension in pregnancy*," "*autonomic nervous system*," and "*pre-eclampsia*." Furthermore, relevant articles uploaded by the authors were also included, which directly address the issue and underlying physiological mechanisms mentioned in this study.

Studies were included if they matched the following requirements: (1) researched on prenatal yoga, yoga-based interventions during pregnancy, or yoga-related physiological mechanisms associated with blood pressure regulation; (2) reported outcomes related to blood pressure, autonomic nervous system activity, stress hormone levels, endothelial function, inflammation, or hypertensive disorders in pregnancy; (3) used research designs such as randomized controlled trials, quasi-experimental studies, cohort studies, cross-sectional studies, or systematic reviews. (4) were published in English between 2020 and 2025, and (5) are open-access publications. Articles were excluded if they did not concern yoga or pregnancy-related populations, were case reports, editorials, comments, or opinion papers, or were not open access.

The article selection process was multi-staged. Initially, titles and abstracts were reviewed to find possibly relevant articles. The full-text papers were then examined using the predefined inclusion and exclusion criteria. Studies that proved irrelevant, methodologically weak, or incompatible with the review's objectives were eliminated. The remaining articles were used for narrative synthesis.

All selected papers were examined using a narrative method, with the results grouped into key thematic domains like autonomic nervous system modulation, stress hormone control, heart rate variability, endothelial function, and inflammatory pathways. This thematic synthesis facilitated the integration of multiple lines of research, resulting in a more thorough understanding of how prenatal yoga could be important for blood pressure regulation. As a narrative literature review, this study did not use usual systematic review techniques or quantitative meta-analysis; rather, each included publication was carefully evaluated for scientific quality and significance. The review presents an integrated perspective on the scientific and psychological mechanisms by which prenatal yoga may help manage blood pressure and minimize the risk of pregnancy-induced hypertension.

3. RESULTS AND DISCUSSION

3.1 Basic Concepts of Prenatal Yoga

Yoga is widely recognized as a complementary therapeutic approach that promotes both physical and mental health through a holistic integration of body and mind (Corrigan et al., 2022). The practice encompasses a combination of physical postures (*asanas*), breathing techniques (*pranayama*), focused attention (*dharana*), and meditation (*dhyana*), all of which collectively support emotional, mental, physical, and spiritual balance (Curtis et al., 2012). With the growing appreciation of holistic strategies within modern healthcare, yoga has increasingly been adopted as a non-pharmacological intervention, including for women during pregnancy (Corrigan et al., 2022).

A growing body of evidence confirms that yoga practiced during pregnancy is both safe and effective. Recent meta-analytic findings indicate that adverse events or injuries associated with yoga are rare, particularly when movements are appropriately modified to accommodate the physiological changes of pregnancy (Lin et al., 2022). Consequently, yoga is frequently recommended by healthcare professionals as a structured form of exercise that supports both physical fitness and psychological well-being in pregnant women (Corrigan et al., 2022). In clinical practice, modifications are typically guided by consultation with obstetric care providers or trained therapists to ensure alignment with gestational age and individual health conditions (Žebeljan et al., 2022).

Yoga represents a comprehensive lifestyle approach that extends beyond physical activity. It emphasizes core principles such as mental calmness (*chitta prasadanam*), compassion (*karuna*), acceptance, and mindfulness as tools for managing everyday stress. These principles are particularly relevant during pregnancy, a period often marked by emotional fluctuations related to bodily changes, physical discomfort, and anxiety during labor. Integrating these elements into prenatal yoga has been shown to support adaptive stress coping mechanisms,

improve emotional regulation, and enhance self-control among pregnant women (Joshi et al., 2024). Moreover, yoga is not only accessible and easy to practice but also offers broader benefits compared with other forms of physical activity, such as walking or conventional prenatal exercise programs (Corrigan et al., 2022).

These observations align with established recommendations for physical activity during pregnancy, which advise at least 150 minutes of moderate-intensity activity per week or at least 30 minutes of exercise on most days of the week. Regular physical activity, including yoga, has been shown to confer benefits that outweigh potential risks, particularly in the prevention and management of conditions such as gestational diabetes and hypertension (Curtis et al., 2012). Accordingly, prenatal yoga may be considered a safe and appropriate exercise option not only for women with uncomplicated pregnancies but also for those with certain pregnancy-related medical conditions, including pregnancy-induced hypertension (Zainiyah et al., 2024).

3.2. The Physiological Mechanism and Stress-Related Effects of Prenatal Yoga on Blood Pressure Regulation

Prenatal yoga has been shown to contribute to blood pressure regulation through multiple interrelated physiological mechanisms, as demonstrated in both experimental research and clinical studies (Karthiga et al., 2022). One of the key mechanisms involves stimulation of the parasympathetic nervous system (Shobana et al., 2022). Through practices such as slow, controlled breathing, meditation, and deep relaxation, yoga enhances vagal tone and, in turn, helps to reduce excessive sympathetic activation or sympathetic overdrive. Sympathetic dominance is known to trigger increased heart rate, vasoconstriction, and stress responses that contribute to hypertension during pregnancy (Deasy et al., 2023). Murugesan et al. stated that yoga alters the autonomic balance in favor of parasympathetic dominance by diminishing sympathetic reactivity, hence resulting in a physiological reduction of blood pressure (Murugesan, 2024). This effect is reinforced by the results of an RCT by Karthiga et al., which showed a significant increase in baroreflex sensitivity and HRV power after yoga intervention in a population of pregnant women at risk of hypertension, indicating an improvement in autonomic regulation directly related to a decrease in blood pressure (Karthiga et al., 2022).

In addition to autonomic modulation, prenatal yoga also helps reduce the secretion of stress hormones, particularly cortisol and catecholamines, by inhibiting hypothalamic–pituitary–adrenal (HPA) axis activity. Excessive activation of the HPA axis increases cortisol, cardiac output, and systemic vasoconstriction, thereby contributing to gestational hypertension (Fernandez et al., 2025). Murugesan et al. showed that yoga lowers cortisol levels by increasing relaxation brain waves that induce a calm state in pregnant women. Lower levels of catecholamines, including norepinephrine and epinephrine, further contribute to blood pressure regulation by diminishing sympathetic drive and reducing cardiac workload. This mechanism is particularly important during pregnancy, a period in which both physiological and psychological stress are closely linked to elevations in blood pressure (Murugesan, 2024).

Another important mechanism involves an increase in heart rate variability (HRV), functioning as a key indicator of autonomic nervous system balance. Higher HRV reflects greater parasympathetic activity and a more stable physiological response to stress (Žebeljan et al., 2022). Evidence from the International Journal of Yoga indicates that yoga practice can enhance HRV even after a brief session. These findings are supported by a randomized controlled trial conducted by Karthiga et al., in which pregnant women who participated in yoga interventions demonstrated significant increases in total HRV, RMSSD, and HFnu. These improvements were directly associated with lower blood pressure levels and a reduced risk of gestational hypertension, suggesting that prenatal yoga effectively addresses autonomic dysfunction commonly observed in pregnancies at risk of hypertension (Karthiga et al., 2022; Murugesan, 2024).

Beyond its effects on the autonomic nervous system, prenatal yoga also improves vascular regulation by increasing nitric oxide (NO) production, a potent vasodilator that promotes relaxation of vascular smooth muscle and reduces peripheral resistance (Karthiga et al., 2022). Studies have shown that yoga practice significantly elevates NO levels in pregnant women at risk of hypertension, with these increases closely linked to enhanced baroreflex sensitivity and reductions in both systolic and diastolic blood pressure (Murugesan, 2024). In addition, yoga has been found to lower endothelin-1 levels, a strong vasoconstrictor implicated in the development of preeclampsia. Improvements in endothelial function are particularly important, as endothelial dysfunction represents a central pathophysiological feature of gestational hypertension (Žebeljan et al., 2022).

Prenatal yoga also demonstrates notable anti-inflammatory effects that further support blood pressure regulation. Pro-inflammatory cytokines such as IL-6 and TNF- α are known to increase vascular stiffness and

resistance, thereby contributing to elevated blood pressure during pregnancy. In the same clinical trial, participants in the yoga group exhibited a significant reduction in IL-6 levels, which was closely associated with increased NO availability and decreased peripheral resistance (Murugesan, 2024). Additionally, yoga practice has been shown to reduce C-reactive protein (CRP) and other inflammatory markers while enhancing endogenous antioxidant activity. Together, these changes improve vascular homeostasis and support placental health, helping to explain how yoga not only lowers blood pressure but may also reduce the risk of preeclampsia (Zainiyah et al., 2024).

These physiological effects are supported by various clinical studies, including research by Murdiningsih et al., which found a significant reduction in systolic and diastolic blood pressure in pregnant women with mild preeclampsia after four weeks of yoga intervention. In the population with mild preeclampsia, systolic blood pressure decreased from 134 to 120 mmHg and diastolic blood pressure decreased from 89 to 79 mmHg after four weeks of practice, confirming that yoga is a safe and effective intervention even in high-risk pregnancies (Murdiningsih et al., 2023). This condition is consistent with observations in non-pregnant populations, including findings from Maharani et al., which reported a consistent reduction in blood pressure after structured yoga. This strengthens the physiological mechanisms of yoga that are stable and can be safely applied to pregnant women (Maharani et al., 2024).

Besides the effectiveness in lowering blood pressure, yoga significantly reduces physiological and psychological stress. Controlled breathing and meditation practices have been shown to inhibit activation of the hypothalamic–pituitary–adrenal (HPA) axis, which plays a crucial role in cortisol production, the primary stress hormone (Marwati, 2025). A study conducted in India confirms that yoga reduces cortisol levels through increased brain wave activity associated with deep relaxation. This decrease in cortisol then leads to a reduction in blood pressure through decreased sympathetic stimulation. In addition, yoga reduces catecholamines such as norepinephrine and epinephrine, which normally increase in response to stress and can worsen hypertension in pregnant women. Thus, this hormonal modulation is the main mechanism in lowering blood pressure and improving emotional stability during pregnancy (Murugesan, 2024). Overall, the integration of autonomic modulation, reduced stress hormones, increased HRV, improved endothelial function through NO, and reduced inflammation makes prenatal yoga an effective, safe, and evidence-based non-pharmacological approach in the prevention and management of hypertension during pregnancy (Žebeljan et al., 2022).

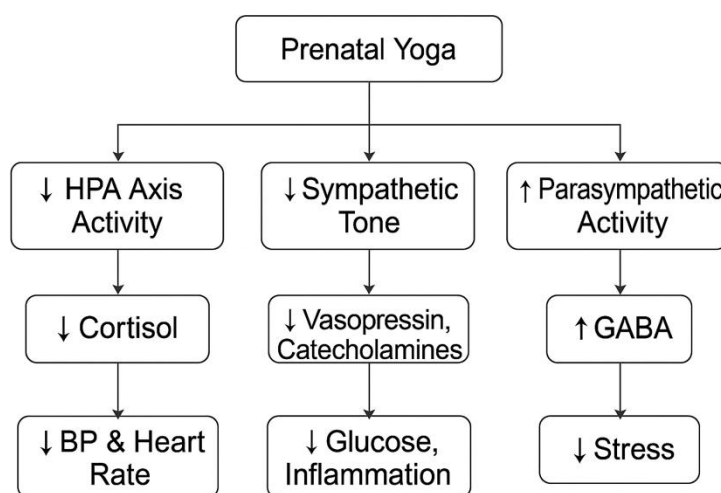


Figure 1. Integrated Mechanisms of Prenatal Yoga on Autonomic Regulation, Stress Reduction, and Blood Pressure Control

3.3. Psychological Well-Being and Stress Regulation in Pregnancy through Prenatal Yoga

Psychological conditions, particularly depression, are among the mental health challenges frequently experienced by women during pregnancy. The prevalence of antenatal depression is estimated at approximately 12%, which is reported to exceed the rate observed in the postpartum period (Marwati, 2025). A range of factors may contribute to this condition, including physiological and hormonal fluctuations, anxiety related to childbirth, and concerns about fetal health. Engaging in light to moderate physical activity, such as yoga, is widely considered

suitable for pregnant women, as it can enhance psychological well-being without imposing excessive physical demands. Numerous studies have demonstrated that yoga is effective in alleviating stress, anxiety, and depressive symptoms during pregnancy (Lin et al., 2022).

One of the key mechanisms underlying the psychological benefits of yoga is the enhancement of self-awareness. Increased self-awareness allows individuals to better recognize their mindset and behavior, facilitating more adaptive responses to stress. Within the framework of self-regulation, self-awareness supports constructive decision-making, emotional regulation, the ability to delay impulsive reactions, and the filtering of irrelevant stimuli. Through practices that incorporate mindfulness, meditation, physical postures, and focused breathing, yoga has been shown to significantly strengthen both self-awareness and self-regulatory capacity (Green et al., 2022).

Stress also plays a critical role in shaping the physiological situation of pregnant women, particularly in relation to blood pressure regulation. Stress-induced activation of the sympathetic nervous system and the hypothalamic–pituitary–adrenal (HPA) axis leads to increased secretion of catecholamines, such as norepinephrine and epinephrine, resulting in elevated heart rate and vasoconstriction. These physiological responses can contribute to increased blood pressure during pregnancy (Khandekar et al., 2021).

Beyond its effects on psychological and cardiovascular regulation, existing evidence indicates that prenatal yoga is associated with improved obstetric outcomes. These include shorter duration of labor, reduced labor pain, and lower rates of perineal trauma and preterm birth. Such complementary benefits suggest that the physiological stability promoted by yoga may extend beyond blood pressure control to support overall maternal and neonatal well-being (Kusumasari, 2023).

3.5. Safety and Adherence

Studies examining the effects of prenatal yoga delivered under the guidance of certified instructors indicate that yoga practice during pregnancy is not only safe but also offers a range of meaningful benefits for expectant mothers. Evidence shows that prenatal yoga is associated with a reduced need for labor induction, a decreased incidence of episiotomy, shorter labor duration, and favorable birth outcomes, including appropriate birth weight and delivery at term (Yekefallah et al., 2021).

Beyond these physiological outcomes, research findings suggest that prenatal yoga is generally well tolerated during pregnancy. In one study, the majority of participants (77.8%) reported no uterine contractions during yoga sessions, while only a small proportion experienced contractions at intervals of 10 minutes (4.4%) or 30 minutes (17.8%), supporting the relative safety of yoga practice for pregnant women. In addition, prenatal yoga has been shown to alleviate pregnancy-related discomfort, enhance self-confidence, and strengthen self-efficacy in preparation for childbirth. Nevertheless, researchers highlight the importance of further randomized controlled trials (RCTs) to strengthen the reliability and generalizability of these findings (Curtis et al., 2012).

As interest in yoga-based interventions among pregnant women continues to grow, emerging evidence points to broader benefits extending beyond physical outcomes. Recent studies have reported improvements in interpersonal relationships, reductions in labor pain, and enhanced quality of life among women who participate in prenatal yoga programs (Villar-Alises et al., 2023). These findings suggest that prenatal yoga may play a valuable role in supporting both physical and psychosocial aspects of maternal health throughout pregnancy.

3.6. Implications for Midwifery Care and Public Health

Antenatal care (ANC) encompasses a range of health services provided to pregnant women to safeguard the well-being of both the mother and the fetus throughout pregnancy. In Germany, ANC extends beyond routine medical check-ups to include non-medical services such as antenatal education, breastfeeding preparation, and yoga or exercise programs designed specifically for pregnant women. These non-medical components play an essential role in supporting overall maternal well-being and highlight the importance of incorporating prenatal yoga into antenatal care, given its long-standing use in supporting women during pregnancy. Recent evidence indicates that prenatal yoga offers substantial physical and psychological benefits for women during the perinatal period (Ludwig et al., 2020). Consequently, prenatal yoga may be regarded as an effective preventive strategy to reduce the risk of pregnancy-related complications (Lee et al., 2025).

Yoga represents a non-invasive and cost-effective approach that promotes harmony on emotional, mental, physical, and spiritual dimensions of health (Curtis et al., 2012). Through breathing exercises, relaxation techniques, and body postures tailored to the needs of pregnant women, yoga supports emotional stability and

mental well-being (Liang, 2024). Regular yoga practice has also been associated with improved overall maternal health. Over time, better maternal health and a reduced risk of complications may contribute to lower healthcare costs during pregnancy and the postpartum period. In this regard, prenatal yoga not only supports immediate physical health but can also be viewed as an investment in the long-term well-being of both mother and child (Lee et al., 2025)

Non-medical ANC activities, including prenatal yoga and childbirth preparation classes, are commonly facilitated by midwives. Beyond delivering educational content and emotional support, midwives serve as educators and counselors who accompany women throughout the course of pregnancy. However, the implementation of antenatal care by midwives often faces obstacles, including a systemic shortage of midwives and a general lack of public understanding of their role and competencies (Ludwig et al., 2020). Strengthening the antenatal care system through collaboration between medical personnel and midwives will make it easier for every pregnant woman to receive comprehensive and continuous care (Heinonen, 2021).

4. CONCLUSION

Prenatal yoga is a safe and evidence-based non-pharmacological intervention that supports blood pressure regulation and reduces the risk of hypertension during pregnancy through interconnected physiological and psychological pathways. Regular practice enhances parasympathetic activity, improves baroreflex sensitivity and heart rate variability, and suppresses sympathetic responses and stress hormone release. Yoga also improves endothelial function by increasing nitric oxide availability and reducing vasoconstriction and inflammatory markers, including IL-6. Clinical evidence demonstrates improved blood pressure control in both healthy and high-risk pregnant women, along with reduced stress, anxiety, and depressive symptoms. Given these consistent benefits, prenatal yoga may be considered a valuable strategy for preventing hypertensive disorders of pregnancy and promoting maternal cardiovascular health, particularly in resource-limited settings.

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