



## Preventive Effect Nanoparticles Moringa Oleifera of Supplementation During Pregnancy Care on Preeclampsia and Anxiety: Study Serotonin Levels

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### KEYWORDS

Nanoparticles of Moringa Oleifera, Serotonin level, anxiety blood pressure. pregnant women.

### ABSTRACT

Preeclampsia, a condition occurring in the third trimester of pregnancy, causes hypertension in mothers and contributes to higher rates of morbidity and mortality among maternal, fetal, and neonatal populations. Non-pharmacological management of hypertension includes using Moringa leaves processed with nanoparticle technology. As a preventive measure, the WHO recommends calcium supplementation for pregnant women. Research indicates that Moringa leaves are rich in flavonoids, calcium, and antioxidants beneficial for expectant mothers. This study aims to demonstrate the efficacy of Moringa Oleifera nanoparticles in reducing anxiety levels and blood pressure in pregnant women with hypertension through a randomized controlled trial. The experiment involved two groups: one receiving Moringa Oleifera nanoparticle extract and a control group. Forty pregnant women with hypertension, averaging 28.60 years old, participated in the study. Results showed significant differences in the treatment group before and after intervention ( $p < 0.001$ ). Moringa Oleifera nanoparticles reduced systolic ( $138.70 \pm 124.90$ ,  $p = 0.007$ ), diastolic ( $88.50 \pm 78.40$ ,  $p = 0.045$ ) blood pressure, increased serotonin levels ( $200.6 \pm 127.6$ ), and decreased anxiety levels (HARS scale) ( $23.30 \pm 16.40$ ,  $p = 0.007$ ). This study confirms that Moringa Oleifera nanoparticles effectively reduce serotonin levels, anxiety, and blood pressure in pregnant women with hypertension.

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## INTRODUCTION

Preeclampsia, a condition that occurs during pregnancy, involves the mother developing hypertension in the third trimester (Akter & Khanum, 2021). This condition significantly contributes to increased rates of illness and mortality among mothers, fetuses, and newborns. Preeclampsia is believed to result from abnormal restructuring leading to excessive production of Endothelin-1. Hypertensive disorders during pregnancy are a major contributing factor to increased morbidity and mortality rates among mothers, fetuses, and newborns. According to the 2013 guidelines from the (Banala et al., 2020) of Obstetricians and Gynecologists (ACOG) on hypertension during pregnancy, approximately 10% of pregnancies globally experience hypertension. In Indonesia, based on Ministry of Health data for 2020, maternal mortality increased from 4,197 cases in 2019 to an estimated 4,627 cases, equating to approximately 230 per 100,000 live births. Data from the Central Java Health Office in 2021 indicated a maternal mortality rate of 98.6 per 100,000 live births (530 cases) in 2020. In 2019, the leading causes of maternal death in Indonesia were bleeding (32%), hypertension (26%), infections (7.3%), and other factors such as heart disease and diabetes mellitus (40.8%).

Furthermore, hypertension during pregnancy is influenced by various factors such as age, diet, multiple pregnancies, and stress (Prins et al., 2022). Anxiety and depression experienced during pregnancy can lead to negative psychological changes in the relationship between the mother and the

fetus. Anxiety prompts the hypothalamus to produce corticotropin-releasing hormone (CRH) in response to stress. Research indicates that anxiety levels in pregnant women rise upon learning of pregnancy risks or complications (Hoyer et al., 2020). CRH, in turn, stimulates the release of adrenocorticotropic hormone (ACTH) and serotonin, which suppress the immune system, specifically immunoglobulin G (IgG).

The nursing care management of hypertension during pregnancy can be addressed through both pharmacological and non-pharmacological means (Thomson, Feeley, Moran, Downe, & Oladapo, 2019). Non-pharmacological treatments refer to interventions that utilize methods, tools, or materials as alternatives or complements to medical interventions. Traditional herbal therapies have been widely used for health management globally and in Indonesia, although their application in pregnancy remains limited (de Boer & Cotingting, 2014). Another non-pharmacological approach to mitigate hypertension risks in pregnant women involves the administration of nano-extracts from herbal moringa oleifera leaves. According to WHO guidelines, it is recommended that pregnant women, especially those at risk, increase their intake of nutrients rich in calcium and antioxidants. Research indicates that moringa leaves are abundant in flavonoids, calcium, and antioxidants, making them beneficial for consumption during pregnancy (Gopalakrishnan, Doriya, & Kumar, 2016).

This study adopts a genuine experimental approach using a randomized pretest-posttest control group design. The study focused on hypertensive pregnant women with blood pressure  $\geq 130/90$  mmHg who sought prenatal care at the Puskesmas. The participants included 40 pregnant women with hypertension.

**METHOD**

This research utilized a true experimental approach with a randomized pretest-posttest control group design. The study was conducted at Puskesmas, where eligible participants were hypertensive pregnant women with blood pressure  $\geq 130/90$  mmHg attending prenatal care. A total of 40 participants were enrolled and randomly assigned to either the intervention group receiving Moringa Oleifera nanoparticles at 500 mg/day or the control group. The primary objective was to measure serotonin levels in serum samples from pregnant women with hypertension.

**RESULT AND DISCUSSION**

The distribution of respondents' characteristics across all groups revealed that a significant portion of respondents were over 35 years old (30%), with the majority having a junior high school education (35%) and not being employed (85%). Based on the aforementioned data, the outcomes of various tests, including Paired T-tests, conducted between the intervention and control groups, focused on the variable Serotonin.

**Table 1.**  
**Characteristics of respondents by Variables, inclusion criteria, and intervention groups**

Indicator	Nano Moringa			Control			Itself
	N	Mean %	SD	N	Mean %	SD	
<b>Age</b>	<b>10</b>	<b>31,20</b>	<b>6,18</b>	<b>10</b>	<b>29,30</b>	<b>4,62</b>	.174
<b>Education</b>							
- ES	1	10	-	3	30	-	.135
- FHS	5	50	-	2	20	-	.358
- HS	3	30	-	4	40	-	.132
- UN	1	10	-	1	10	-	.606
<b>Work</b>							
- Work	4	40	-	0	0	-	.241
- Doesn't work	6	60	-	10	100	-	.966

<b>Anxiety/ Hars Scale</b>	10	23,30	7,57	10	18,60	8,37	.623
<b>Serotonin</b>	10	213,32	156,42	10	200,63	177,20	.109

**Table 2.**  
**Distribution of Average Serotonin Levels and HARS Scale Before and After Intervention in Intervention and Control Groups**

Variable	Group	Mean pre	Mean post	Mean differenced	SD	P-Value
Serotonin	Intervention	106.63	128.39	21.76	15.347	0.002
	Control	200.63	127.63	73.00	228.087	0.338
HARS	Intervention	18.90	9.50	9.40	6.75	0.002
	Control	18.60	18.80	-0.20	0.422	0.168

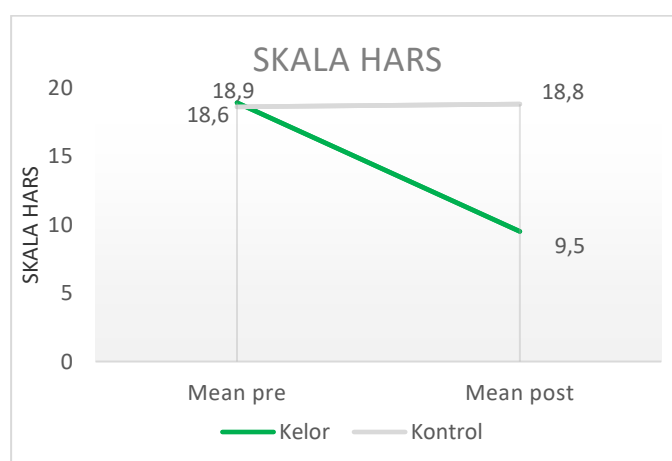
The intervention analysis results for the group indicated a mean of 106.63 ( $\pm 128.39$ ), with a standard deviation of 15.347, and a significant p-value of 0.002. Conversely, the analysis of the intervention in the control group before and after showed a mean of 200.63 ( $\pm 127.63$ ), with a standard deviation of 228.087, and a non-significant p-value of 0.338.

The paired t-test was conducted to compare anxiety levels between the intervention and control groups. Before the intervention, the mean anxiety score in the intervention group was (18.90 $\pm$ 9.50), with a standard deviation of 6.75, and a significant p-value of 0.002. In contrast, the control group showed a mean anxiety score of (18.60 $\pm$ 18.80), a standard deviation of 0.422, and a non-significant p-value of 0.168 post-intervention. These findings indicate that nanoparticle moringa oleifera effectively increased serotonin levels and reduced anxiety among pregnant women.

Once the data was confirmed to follow a normal distribution and exhibit homogeneity, the One-Way Anova test was conducted. The results indicated a significant difference in average Anxiety test scores across intervention groups (p = 0.006). Similarly, the Serotonin variable showed a significant average difference in test scores among intervention groups (p = 0.042).

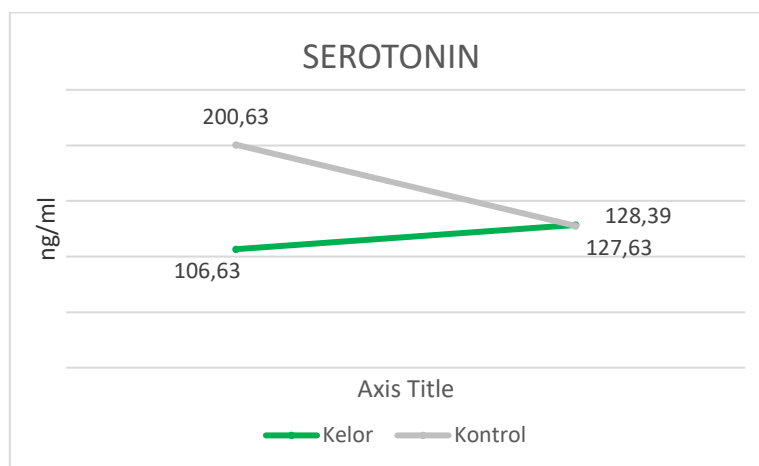
#### Changes in Anxiety Levels (HARS Scale) and Serotonin Levels

The results of anxiety levels (HARS scale) based on the type of treatment given, in detail, can be seen in the figure below.



**Figure 1. HARS scale changes by Group Treatment between Pre and Post**

Figure 1. showed an average change in anxiety levels (HARS scale) before and after no PEMO was administered showed an average (106.63 $\pm$ 128.39), and the control group experienced an average decrease (200.63 $\pm$ 127.63).



**Figure 2. Changes in Serotonin Levels by Treatment Group between Pre and Post**

Figure 2. showed average changes in serotonin levels before and after Treatment NoPEMO showed an average ( $106.63 \pm 128.39$ ) and the control group experienced an average decrease ( $200.63 \pm 127.63$ ).

The study analysis revealed that administering nanoparticles derived from Moringa leaf extract led to elevated serotonin levels and a corresponding reduction in anxiety levels (Fidelis et al., 2024). Existing literature suggests that decreased serotonin levels are linked to anxiety disorders, depression, and suicidal tendencies, often observed in patients with low cerebrospinal fluid serotonin levels and reduced serotonin uptake.

Moringa oleifera, known for its medicinal properties such as antioxidants, anticonvulsants, anti-inflammatory agents, and neuroprotective effects, has shown promising results in studies involving Wistar rats (Hassan et al., 2021). Administration of Moringa oleifera has been found to enhance neuroplasticity and cognitive behavioral function in these animals, while also influencing energy metabolism positively and reducing oxidative stress. These findings suggest that further development of Moringa oleifera could be beneficial for protecting the brain against oxidative stress-related injuries (J. Hashim, Vichitphan, Boonsiri, & Vichitphan, 2021). Additionally, Moringa oleifera is rich in calcium, which has been linked to depression levels and cognitive function in research on vitamin D and calcium effects. Depression levels have shown a significant correlation with blood calcium levels and overall health status, while cognitive function has been notably associated with blood vitamin D levels (Parker, Brotchie, & Graham, 2017).

The research findings indicated a reduction in anxiety levels among pregnant women with hypertension following administration of nanoparticles containing Moringa leaf extract (Adamu et al., 2023). Anxiety and depression experienced during pregnancy contribute to adverse psychological effects on both the mother and the fetus. Previous research has demonstrated that awareness of pregnancy risks or complications tends to elevate anxiety levels in expectant mothers (Biaggi, Conroy, Pawlby, & Pariante, 2016). Robertson et al.'s study revealed that early pregnancy depression and anxiety correlate with an increased risk of preeclampsia. Anxiety triggers the hypothalamus to produce corticotropin-releasing hormone (CRH) as part of the biological stress response. This hormone stimulates the secretion of Adreno Cortico Tropin Hormone (ACTH) and serotonin, which suppresses the immune system, including immunoglobulin G (IgG) (Berczi, 2019).

Certain studies indicate that a serotonin imbalance can lead to mood disorders like anxiety, anger, and depression (Liu, Zhao, & Guo, 2018). Insufficient levels of the amino acid tryptophan in the body contribute to this imbalance. Tryptophan, a key component in serotonin production, cannot be synthesized by the body and must be acquired through dietary sources. Serotonin is synthesized from tryptophan derived from consumed foods such as fish and omega-3 fatty acid-rich nuts, as well as soy and dairy products (Singh et al., 2022).

According to the study, there are multiple methods to boost serotonin levels in the body beyond medication and supplements (Schefft, Kilarski, Bschor, & Köhler, 2017). Non-pharmacological therapies such as acupuncture, acupressure, and herbal remedies rich in calcium and omega-3 can also be effective. Additionally, regulating diet, particularly exposure to sunlight, activates serotonin production, contributing to increased levels of this hormone. Another alternative for individuals experiencing mood disorders is exercise, which enhances motor activity and stimulates serotonin neuron activation (Alizadeh Pahlavani, 2024).

## CONCLUSION

The study findings revealed a significant difference ( $p < 0.001$ ) between treatment groups before and after the intervention. The administration of 500 mg/day of moringa oleifera nanoparticles significantly decreased anxiety levels and increased serotonin levels, potentially contributing to the prevention of preeclampsia in hypertensive pregnant women.

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